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Devoted to Science, Engineering, and Mechanic Arts,

Especially on the Pacific Coast.

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SAN FRANCISCO.

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"INDUSTRY"

INDEX FOR 1892

"INDUSTRY."

JOHN RICHARDS, Editor.

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SAN FRANCISCO.

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VISIT OF THE MECHANICAL ENGINEERS.

The proposed spring meeting of the American Society of Mechanical Engineers in this City next May, aside from the facts which will be noticed further on, furnishes an opportunity for some comment on the profession.

It is only a little way back into the past when the enormous field now covered by the term mechanical engineering, was little more than empiricism. Exact methods, or science, were confined to that branch now distinguished in this country as civil engineering, embracing much, it is true, of mechanical construction, but ignoring to a great extent, manipulative processes, and machine functions.

The cörelation of forces was a dream at the beginning of the century, and the missing link required to connect exact knowledge with machine action was wanting. The establishment, or, rather, the acknowledgement of the mechanical relations of heat, completed the circuit, so to speak, and all at once, or in a very short time, began the application of exact methods in the investigation of machine functions. From this naturally followed machine construction and the various conditions and operations connected therewith.

The empirical part, which must always remain a considerable one, in mechanical engineering, gave zest to the efforts of investigation. In static structures, such as form the main object of civil engineering pursuits, the quantities and conditions were ascertainable and consequently, computable. Constant strains, or those arising from constant causes, came within the scope of mathematical treatment. The properties of material, the next most important element, by means of experiments and tabulated results throughout the world, furnished data to hand, ready made, and exact, so that a good education and acquaintance with recorded precedents went far toward constituting the profession of a civil engineer.

In mechanical engineering the same circumstances do not exist. The intimate connection with manipulative processes, that are, of necessity learned experimentally, was, and is, a great impediment to exact treatment and computed results. Strains, the qualifying element in machine design, are not only non-computable but not ascertainable, because "accidental." The factor of safety can not be based upon ultimate strength and proportions be thus derived, because the degrees, or intensities, of stress are accidental. They cannot be ignored, however, and their measure has to be assumed from observation, analogy and inference.

The same impediments are met with in respect to materials, not only has resistance to strains to be considered, but endurance under wear, under varying pressure, and on surfaces of unsymmetrical form. The effects of heat, crystalization and flexure, and the phenomena of lubrication, have to be considered. The way has been beset with difficulties on all sides, but patient perseverance and coöperative research has finally erected out of this chaotic mass a science, or, at least, has raised the art to a basis that may be fairly called an "engineering" one.

Another contributing cause to the great changes in mechanic art has been in supplanting manual skill with machine implements, and substituting dexterity with intelligence. Every such change brings manipulative processes more within the realm of computation and exact methods. How far this is to go, no one can now foresee. Its ethical phases constitute the main problem of our time. The social disturbances of our day are traceable mainly to the altered relations brought about by machine effect, its influence on production, and on the social conditions of people.

In this brief review of some of the causes can be seen the agencies through which has arisen the profession we call "mechanical engineering."

At the late meeting of the American association, in New York, the *Daily Tribune* contained a notice of the American Society of Mechanical Engineers, from which the following excerpts are made:

"Only a few years ago the profession of mechanical engineering was practically unknown, and certainly unrecognized, in this country. The able men whose genius even then adorned this branch of engineering were rather looked upon as the educated members of a useful trade, a species of cultured mechanics. Today the Society of Mechanical Engineers, the most vigorous and progressive of the sisterhood of engineering associations, has over 1,300 members on its rolls, own a club house situated a few doors from Fifth Avenue, in the heart of the city, purchased at a cost of $60,000, and combines the vigor of youth with the stolidity of maturity. * * * * * *

While this vigorous young society of the work bench and the forge has its home and friends in New York, it is yet co-extensive with the Nation in sympathy and scope. The spring meetings are held at various places throughout the country, and thus, at intervals the members of every geographical section are gladdened by the visit of their professional friends. Next May it will strike for the far West. The regular spring meeting will be held in San Francisco, in the early part of the month."

We applied to Prof. Frederick R. Hutton, the secretary of the Society, for some of the principal facts in the origin and rise of the association, of which he has been the secretary since 1883. In his answer Professor Hutton says: "It is a little difficult to send you any matter which will give a history of our Society without, unfortunately, involving therein a certain amount of friendly comment upon myself." This, we find, is quite true as to "fact," but fail to see the "misfortune"; indeed, the life and progress of such an association is, to a great extent, measured by the capacity and vigor of the secretary, or executive officer, which he is, in fact.

Professor Hutton's part in building up the Society has been, perhaps, the most notable among a good many notable works of his, and his modesty in the matter is as commendable as the comments that have disclosed it.

It will be a pardonable pride to point out that the association is one of the most important of the kind in this country, in so far as influence over the industrial interests of the Nation, and the visit here will be, in many respects, the most notable of the kind that our City has enjoyed.

The thoughtful essay of Mr. Dickie, printed in the present number of Industry, will serve as an example to show how intimately the economics of public interests are connected with the "mechanics of execution." It is an interwoven whole, and from our visiting friends much may be learned of means and incentives to improve our present industrial and commercial environment.

It is too soon to discuss the various circumstances attending upon the event, further than to bespeak earnestly full coöperation and support on the part of our manufacturers, merchants, engineers, and all interested in the future welfare and good name of our City and people. A communication from Professor Hutton, printed elsewhere, will show the arrangements so far as completed at this time.

THE COMMERCE OF SAN FRANCISCO.

WHAT IS REQUIRED TO REVIVE AND STIMULATE THE TRADE OF THE PORT.

BY GEORGE W. DICKIE.

We have been so accustomed to hearing the enterprise of San Francisco and California lauded, and the facts relating thereto exaggerated to such an extent, that the pleasant sound of our self-blown horn has lulled us into a profound sleep.

The noise of the Traffic Association wakes us up to a realization of the fact that we have been sleeping for about twenty years, securely shut up and carefully guarded by a trans-continental staff of dry nurses, who have been very careful not to kill us outright, but to keep us in a helpless condition.

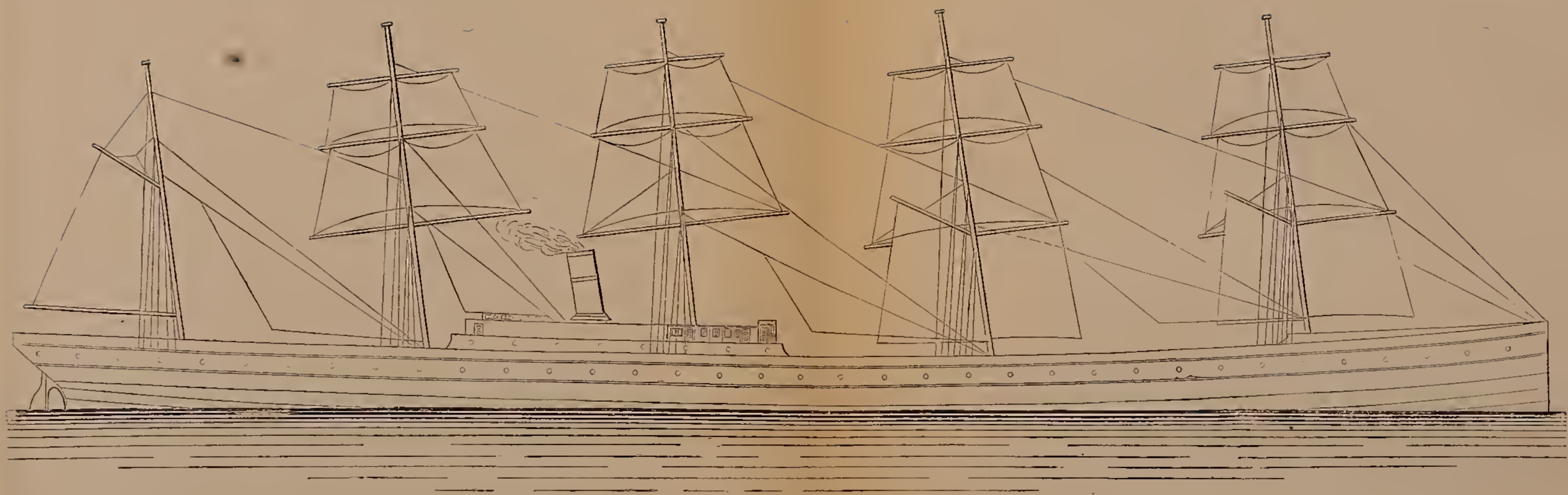
They have dosed us to such an extent as our weakened constitution—that is, our traffic—would bear without a total collapse.

There is no great city in the world, pretending to be commercial, and situated as this City is, that has not in the past ten years, made more rapid progress than San Francisco. How is it, that having such a magnificent situation on the broad waters of the Pacific, with the Golden Gate for a "front door," her merchants enter their goods at New York, haul them across the continent, and in at the "back door?"

Our merchants are in anguish because every town west of the Rocky Mountains is entered at the back door, by the common carrier, on the same or better terms, than the City by the sea. If our merchants will enter their goods by the front door, and sell at the back door we will have the western side of the United States for a customer, instead of having every town for a rival, and our Traffic Association can settle with the carrier for rates to all points east of the port of San Francisco.

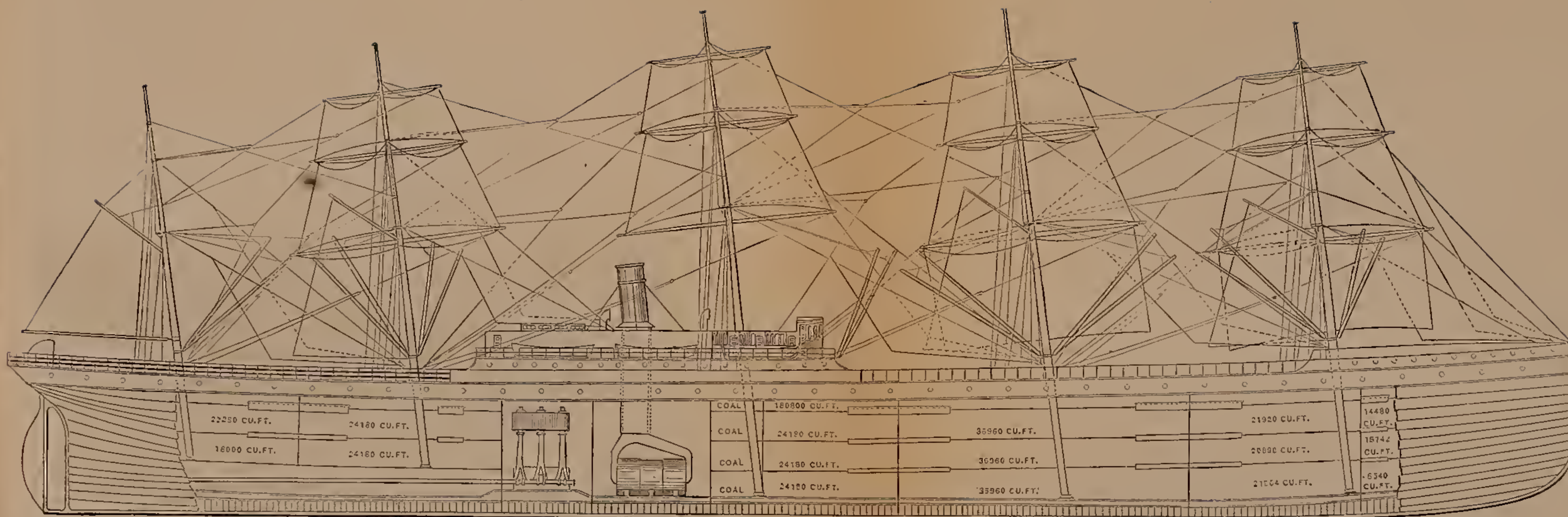
It is my purpose to show the commercial men of San Francisco and California how to take advantage of our position as the natural entry port for all commercial products required for consumption in the states and territories west of the Rocky Mountains.

If we but glance at the commercial history of the great cities, both ancient and modern, we will find that their prosperity depended upon the completeness with which they took advantage of their posi-



OUTBOARD PROFILE.

· Steamship COUNTY OF CONTRA COSTA, Pioneer Ship of the "County Line."



INBOARD PROFILE.

SPAR DECK PLAN.

STEAMSHIP COUNTY OF CONTRA COSTA, PIONEER SHIP OF THE "COUNTY LINE."

tion relative to water-borne commerce, making the countries and people behind them, dependent upon their favorable position relative to the ocean. It is true that great cities arose as centers of inland commerce in ancient times, as well as in modern. Ancient Palmyra, was built in the middle of a desert, because there great lines of travel met. Such locations are artificial, and merely accidents of commerce, being born of the necessities of commerce. Our case is different. We are not necessary to commerce, as we see to our loss that it can go in other directions, but commerce is absolutely necessary to us. The building up and developing power of commerce is a very conspicuous factor in the history of the great centers of population. This principle helps us to understand why the earliest seats of population should be on the Euphrates, the Nile, the Ganges, and the Blue and Yellow rivers of China, and how the cradle of ancient maritime commerce should be found in communities scattered along the coasts and round the islands of the Mediterranean Sea.

Nothing is more marked in the past history of the world than the struggles of commerce to establish conditions of security and practical means of communication with distant parts. When driven from the land by restrictions and imposts, it would seek for freedom and safety in the sea. If Rome was all powerful on the land, Carthage ruled on the sea. The strength of Rome was in her legions—that of Carthage in her ships, and her ships could cover ground that the legions could not reach. She stretched her commerce beyond the mystic pillars of Hercules into the Atlantic and founded the port of Cadiz. Later, the Venetian refugees, stretching their hands over the sea, found in its fish and salt, and in the rich commerce it opened up to them, more than compensation for the fat lands and inland towns from which they had been driven, so that in the course of time, from the security of her position, and the enterprise of her merchants, Venice became practically mistress of the sea. There the first public bank was organized; there bills of exchange were first negotiated; and funded debt became transferable; there finance became a science and book-keeping an art.

Coming down to modern communities, we find the same conditions necessary to commercial success—an open door to the ocean, the common highway of nations, and enterprise to use it.

It is London's doorway to the ocean by the Thames that makes her the commercial head of England. Liverpool has become great and wealthy by making the most of her door by the Mersey, and

Manchester is now spending many millions to get out at the same door, although all the wise railroad people blame her for spending her money so foolishly. Glasgow has made quite a fine front entrance out of a little river, making the Clyde famous the world over. Bonnie Dundee, on the classic Tay, from a small beginning in flax, from the adjacent Baltic, by a judicious use of its front door, has become a great emporium of flaxen and jute fabrics; and in the New World the same conditions produce the same results. New York, Boston, Philadelphia, New Orleans, are all great commercial centers, because they are careful to make a proper use of their position, entering their imports by their own front door.

San Francisco suffers, and her commerce languishes, because she does not take advantage of her position as the natural entry port for the western side of this Great Republic. From conversation with many of her merchants, I can see that this fact is readily admitted on all sides. Now, can the existing state of things be bettered for not only our commerce, but for our manufacturers, that depend on the East, or Europe, for raw material and a market? Time is never allowed for a manufacturer to get his material by sailing vessel, so the cost of rail transportation has to be added to his estimate, and that usually sends the work to some other manufacturing center that knows better than San Francisco how to take advantage of the situation.

We of San Francisco must learn to benefit from the history of other countries, and seek our fortunes where so many have found theirs. Our advantages, as regards ocean transportation, are equaled by few cities in the world. Our magnificent harbor is ready made to our hand, and we only need the instruments to work out our own salvation. We want, in short, a line of steamships specially designed for the requirements of commerce between San Francisco and Liverpool, and San Francisco and New York, and as the sailing ship service between these ports has at all times commanded the service of the finest sailing ships afloat, so the new requirements of this commerce, that will give to our merchants fixed dates for sailing, and approximately fixed dates for arriving, require a line of freight steamships, whose passages will be as regular and certain as the new White Star freight steamships on the Atlantic. Transient tramp boats picked up here and there, and with no fixed time either to come or go, and with no capacity for work, will never do much toward making San Francisco the port of entry for the commerce handled by her merchants.

Second-hand tools cannot be picked up for this kind of work. They can only be procured in one way, and that is to build them. At various times during the last ten years I have advocated the building of such a line of steamships, and discussed it in all its bearings with leading merchants, and the only argument ever used against it has been that it would simply be drawn into the great combine and either be stopped or run for some other purpose than for the good of the commerce of this port. This kind of argument simply shows how weak and timid our merchants have become under the back door system.

San Francisco, with California behind her, can build such a line of steamships, and operate them to the building up of our commerce and the benefit of their owners, and the railroads would soon learn that to carry from our wharfs and warehouses into the interior was a more respectable and profitable business than being at the far end of a trans-continental system.

I have been much encouraged in discussing this subject lately with merchants and members of the Traffic Association, to notice that the subject has become one of great interest, and that a desire is manifested to investigate the details of such an enterprise and how it could be put in practical shape.

I have prepared plans of the vessels I would propose for the "California County Line of Steamships" to Liverpool and New York via the Straits of Magellan. The proposed vessels will be of the following dimensions:

Length over all	484 feet
Beam	49 feet 6 inches
Depth to spar deck	41 feet

The engines would be triple expansion, and the boilers would have a working pressure of 175 pounds per square inch. Evaporators would be used to supply all waste by fresh water. This is a prime necessity for such long voyages. The size of engines would be 26 inch high pressure; 42 inch intermediate pressure, and 72 inch low pressure; the stroke of piston being 60 inches. This machinery will give a speed of 11 knots, so that the daily distance made may be taken at 250 knots average, or about 48 days, and we will assume that 50 days would be the average time for all vessels of the County Line, to or from Liverpool and New York.

The gross register tonnage under the spar deck would be 5,890 tons. The capacity of the holds, for measured freight would be 589,256 cubic feet, or 14,731 tons. Deduct 20 per cent. for dunnage and stowing, and we have a capacity for measured freight of 11,785 tons. This we may safely place at 10,000 tons, at 26 feet 6 inches draught of water, as the *County of Contra Costa* is shown on our outboard profile. The dead weight carrying capacity, independent of 1,700 tons of coal in the bunkers, will be 6,200 tons. The mean indicated horse power will be 2,200, and the consumption of fuel—first-class steam coal—will be 33 tons per day, or 1,584 tons on each voyage. This gives four day's spare coal, perhaps not quite enough, but the bunkers have been provided for 2,000 tons, and it is not likely that the whole carrying capacity of the vessel would be required for dead weight freight. Leaving San Francisco, drawing 26 feet 6 inches of water, the *County of Contra Costa* would arrive in New York or Liverpool drawing 23 feet 6 inches.

Our inboard profile of the *County of Contra Costa*, shows the main divisions of the holds. She would be built as a three-decked vessel, with an orlop deck, ten water-tight bulkheads; all of which would be carried to the spar deck.

Independent of the question of safety, this subdivision is necessary on account of the varied kinds of merchandise that would be carried. Produce shippers from this end could secure one compartment, and thus keep their freight separate from others. Twenty-six independent holds are thus provided. Loading or discharging can go on independently at eight hatches at the same time; double hoisting engines would be provided at each hatch, and double cargo booms for each hatch. The arrangement of hatches has determined the rig of the *County of Contra Costa* as a five-masted vessel, carrying square sails on four masts. The canvas spread will enable this vessel to take advantage of favorable winds to save fuel or cover distance, and also enable her to take care of herself in case of any accident to the machinery. An electric light plant will be provided, and a powerful search light installed on the forecastle deck; this will be of great service in going through the Straits.

It will be observed that in the design of this vessel nothing has been sacrificed for the sake of cheapness. The commerce of San Francisco requires first-class facilities. Safety and regularity are of the first importance, and must never be sacrificed. These vessels will each cost $680,000.00, and in order to have a vessel leave San Francisco on the 1st of each month for Liverpool, and one on the 15th of each month for New York, ten such vessels will be required to complete the line. The question is usually asked at this stage: Where are the ships to come from? I only know of one place that a ship can be expected to come from, and that is a ship-building yard. In other words, we must build them.

But it takes a long time to build such a vessel. Yes, it will take a year to build the first one, but the others can follow at three months' intervals; and I will show that that is as fast as the business can be got into working shape. Merchants must have time to arrange for the changes necessary in the method of doing business. Merchants in interior towns must come to San Francisco to buy instead of going to New York, and it takes time to effect such changes, just as it takes time to build ships.

Who would own such a line of ships and provide the means to build them? The importing merchants of San Francisco; the farmers and fruit growers of the State, and whoever else had means and wanted a good investment. How can we bring these people together? I would not seek to bring them very close together; in other words, I would have independent ownership in each vessel; the line to be operated by a managing owner, who shall own the same interest in each vessel.

Let a shipping house of high standing, well known at each end of the line, and that has the confidence of the shippers throughout the State, and the merchants of the City, act as managing owner, and start the building of the *County of Contra Costa*. The managing owner will hold ten one-hundredths; the builders of the vessel will hold ten one-hundredths; the captain to command the vessel will hold five one-hundredths. He would only be allowed to own in the ship he commands. This leaves seventy-five one-hundredths to be taken by the merchants of the City and the producers of the State. The managing owner attends to all business for a percentage of the earnings of the vessel. Each vessel of the line would have its own individual account, which would be closed up and the net profits divided at the end of each round voyage. Each owner can handle his own share as it suits him; can dispose of it as he pleases. Can insure it or carry the risk as he sees fit.

The second ship would be laid on the blocks three months after the first, and so on, until the line had reached the proportions required by the commerce of the State.

The following time schedule would show how the County Line would come into operation. A study of this, I think, will convince the merchants and producers that such a line can be brought into operation as fast as the changes in business can be brought about:

TIME SCHEDULE

"COUNTY" LINE OF STEAMSHIPS

FROM

SAN FRANCISCO TO LIVERPOOL AND NEW YORK.

NAMES OF SHIPS.	LEAVE SAN FRANCISCO	ARRIVE LIVERPOOL	ARRIVE NEW YORK.	LEAVE LIVERPOOL	LEAVE NEW YORK	ARRIVE SAN FRANCISCO
County of Contra Costa	Jan. 1, 1893	Feb. 19, 1893		Mar. 15, 1893		May 4, 1893
" Santa Clara	Apr. 1 "		May 20, 1893		June 15, 1893	Aug. 4 "
" Contra Costa	June 1 "	July 20 "		Aug. 15 "		Oct. 4 "
" Sacramento	July 1 "		Aug, 19 "		Sep. 15 "	Nov. 4 "
" Santa Clara	Sept. 1 "	Oct. 20 "		Nov. 15 "		Jan. 4, 1894
" San Joaquin	Oct. 1 "		Nov. 19 "		Dec. 15 "	Feb. 3 "
" Contra Costa	Nov. 1 "	Dec. 20 "		Jan. 15, 1894		Mar. 6 "
" Sacramento	Dec. 1 "		Jan. 19, 1894		Feb. 15, 1894	Apr. 6 "
" Fresno	Jan. 1, 1894	Feb. 19, 1894		Mar. 15 "		May 4 "
" Santa Clara	Feb. 1 "		Mar. 22 "		Apr. 15 "	June 4 "
" San Joaquin	M'ch 1 "	Apr. 19 "		May 15 "		July 4 "
" Tulare	Apr. 1 "		May 20 "		June 15 "	Aug. 4 "
" Contra Costa	Apr. 15 "	June 4 "		July 1 "		Aug. 19 "
" Sacramento	May 1 "		June 19 "		July 15 "	Sept. 3 "
" Fresno	June 1 "	July 20 "		Aug. 15 "		Oct. 4 "
" Los Angeles	July 1 "		Aug. 19 "		Sep. 15 "	Nov. 4 "
" Santa Clara	July 15 "	Sept. 3 "		Oct. 1 "		Nov. 19 "
" San Joaquin	Aug. 1 "		Sept. 19 "		Oct. 15 "	Dec. 4 "
" Tulare	Sept. 1 "	Oct. 20 "		Nov. 15 "		Jan. 4, 1895
" Contra Costa	Sep. 15 "		Nov. 4 "		Dec. 1 "	Jan. 19 "

TIME SCHEDULE CONTINUED

County of Colusa	Oct. 1, 1894	Nov. 19, 1894		Dec. 15, 1894		Feb. 3, 1895
" Sacramento	Oct. 15 "		Dec. 4, 1894		Jan. 1, 1895	Feb. 19 "
" Fresno	Nov. 1 "	Dec. 20 "		Jan. 15, 1895		Mar. 6 "
" Los Angeles	Dec. 1 "		Jan. 19, 1895		Feb. 15 "	Apr. 6 "
" Santa Clara	Dec. 15 "	Feb. 3, 1895		Mar. 1 "		Apr. 19 "
" Solano	Jan. 1, 1895		Feb. 19 "		Mar. 15 "	May 4 "
" San Joaquin	Jan. 15 "	Mar. 6 "		Apr. 1 "		May 19 "
" Tulare	Feb. 1 "		Mar. 22 "		Apr. 15 "	June 4 "
" Contra Costa	Feb. 15 "	Apr. 6 "		May 1 "		June 19 "
" Colusa	Mar. 1 "		Apr. 19 "		May 15 "	July 4 "
" Sacramento	Mar. 15 "	May 4 "		June 1 "		July 20 "
" Yolo	Apr. 1 "		May 20 "		June 15 "	Aug. 4 "
" Fresno	Apr. 15 "	June 4 "		July 1 "		Aug. 19 "
" Los Angeles	May 1 "		June 19 "		July 15 "	Sep. 3 "
" Santa Clara	May 15 "	July 4 "		Aug. 1 "		Sep. 19 "
" Solano	June 1 "		July 20 "		Aug. 15 "	Oct. 4 "
" San Joaquin	June 15 "	Aug. 4 "		Sept. 1 "		Oct. 20 "
" Tulare	July 1 "		Aug. 19 "		Sep. 15 "	Nov. 4 "
" Contra Costa	July 15 "	Sept. 3 "		Oct. 1 "		Nov. 19 "
" Colusa	Aug. 1 "		Sep. 19 "		Oct. 15 "	Dec. 4 "
" Sacramento	Aug. 15 "	Oct. 4 "		Nov. 1 "		Dec. 20 "
" Yolo	Sept. 1 "		Oct. 20 "		Nov. 15 "	Jan. 4, 1896
" Fresno	Sep. 15 "	Nov. 4 "		Dec. 1 "		Jan. 19 "
" Los Angeles	Oct. 1 "		Nov. 19 "		Dec. 15 "	Feb. 3 "
" Santa Clara	Oct. 15 "	Dec. 4 "		Jan. 1, 1896		Feb. 19 "
" Solano	Nov. 1 "		Dec. 20 "		Jan. 15, 1896	Mar. 5 "
" San Joaquin	Nov. 15 "	Jan. 4, 1896		Feb. 1 "		Mar. 21 "
" Tulare	Dec. 1 "		Jan. 19, 1896		Feb. 15 "	Apr. 5 "
" Contra Costa	Dec. 15 "	Feb. 3 "		Mar. 1 "		Apr. 19 "

The next question, and a very important one, is: What will the operating expenses be, and how will the revenue compare with expenses? To estimate this, I will take the first voyage of the *County of Contra Costa*. By reference to our time schedule it will be observed that this vessel leaves San Francisco on the 1st of January, 1893, and leaves again on her second voyage on the first of June; that is, five months for the round voyage. Expense will be:

1,600 tons of coal, at $8.00	$ 12,800 00
1,600 " " " 4.00	6,400 00
CREW OF FIFTY, ALL TOLD.	
Captain (5 months)	1,000 00
Chief engineer (5 months)	750 00
First mate (5 months)	500 00
Second and third mates (5 months)	600 09
" " engineers (5 months)	825 00
Four quarter masters (5 months)	900 00
Twelve seamen "	1,800 00
Two cooks and one steward (5 months)	625 00
Eight apprentices "	600 00
Six oilers and water tenders "	1,350 00
Nine firemen "	1,800 00
One storekeeper "	225 00
Provisions for fifty hands, 151 days at 42 cents	3,171 00
Port charges at Liverpool, including going in dry dock	5,800 00
Port charges in San Francisco	3,000 00
Five months' supply of paints, oils, waste, hardware, etc	1,480 00
Ship chandlery bills	900 00
Machine shop bills	1,600 00
Managing owners' percentage	3,600 00
Advertising and stationary	600 00
Incidentals	1,000 00
Total expense	$51,326 00

In regard to the revenue, we have seen that the *County of Contra Costa* has ample room for 10,000 tons measured goods, and that her dead weight carrying capacity is 6,200 tons of cargo. I think that it would be quite safe to assume that the average number of tons each way would never be less than 6,000. Now, as to the average rate of freight per ton. Some classes of freight would be carried for less than $10 per long ton, but a large proportion would be over that rate, and for a short ton, which would increase the amount carried by 600 or 700 tons. If we take an average of $10 per long ton (I am sure that is below the most sanguine hopes of our merchants and producers), that will give a gross revenue for the five months of $120,000. Deducting operating expenses, there is left a net revenue to be divided among the owners of $68,674, or 10 per cent. dividend for five months—24 per cent. per annum. To owners that insure, there would still be left from 18 to 19 per cent. per annum.

I have endeavored to place this proposal in a simple form before the merchants of San Francisco and the producers of the State. I have studied the question for years; discussed it with the most intelligent shipping men here and elsewhere. It is in opposition to no railroads, in fact, I would consider it the greatest factor in building up the railroads, radiating in all directions from this City as the center of commerce, and natural emporium of the West.

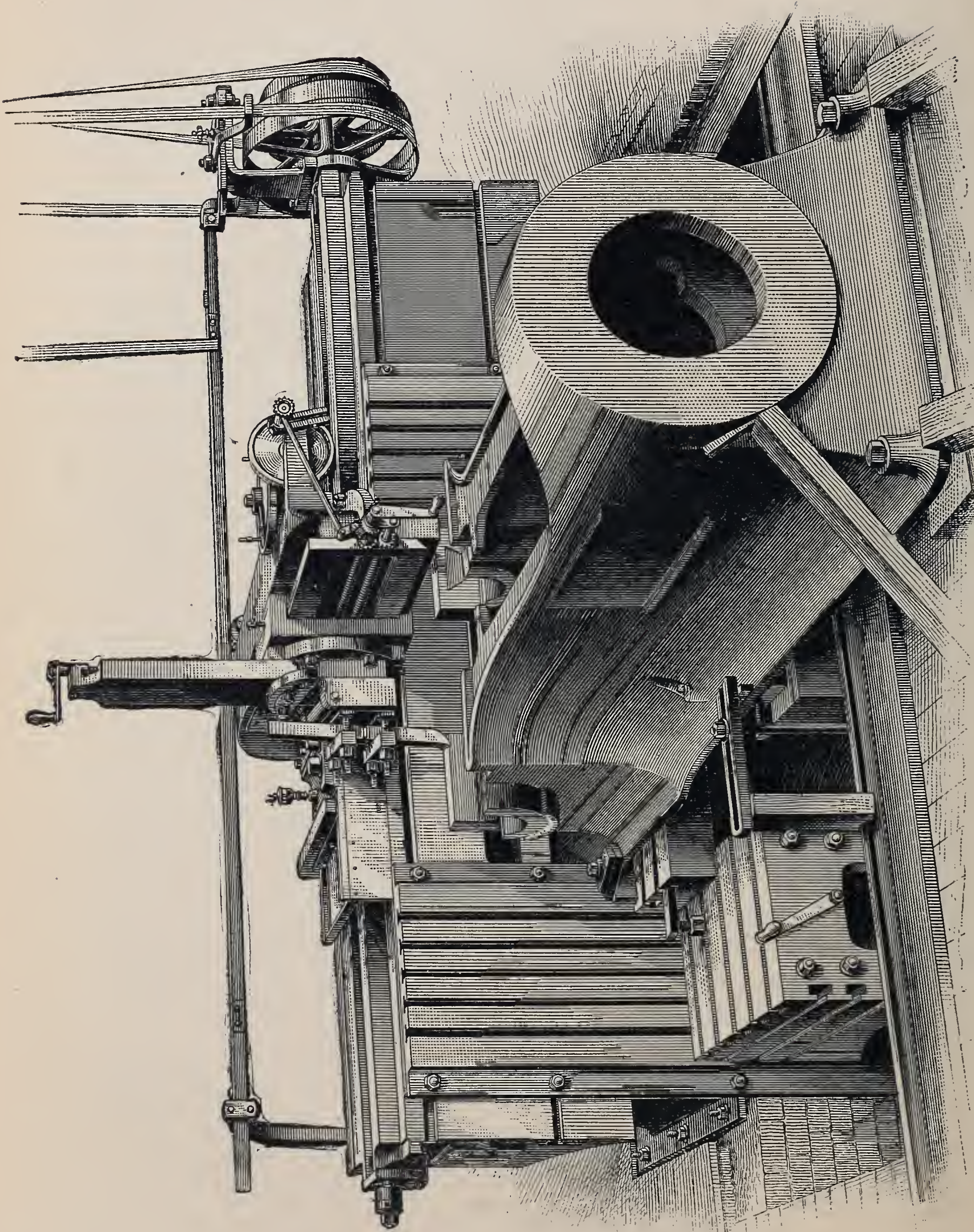
There is nothing to prevent our merchants and producers from establishing such a line of steamships, and they can all be built here, and in time to take their places in the line as indicated in our time schedule, and when they are all completed, as a community we will be richer, as we will have the ships and the money with which they were built as well.

If a canal is ever completed through the attenuated waist of this continent, the first ship to pass through should be one of the "County Line," representing the commerce of San Francisco.

Now seems a favorable time to begin such an enterprise. Is it natural for the merchants of our interior towns to go to New York or Philadelphia to buy imported goods, and haul them across the continent on a railway, with San Francisco and her fine harbor so near? What advantage in time, for goods shipped from Europe over the Atlantic by steamer and across the continent by rail, is there over shipping by steamer direct with a time schedule of 50 days, and fixed days for sailing? The gain in time is very slight, if any, while the cost is very much greater, and freight by the steamship line has the advantage of being handled only once.

It is needless for me to expand this subject further. Each merchant can figure out what advantages such a line of steamships would give him, with a time schedule and freight rates as indicated, over his present condition.

The conditions of all are not alike. But, if such an enterprise, honestly managed, would not give an immense impetus to the commerce of California, we have been greatly deceived as to the causes that have retarded our progress.



RICHARDS' SIDE-PLANING MACHINE.—PEDRICK & AYER, PHILADELPHIA.

METHODS OF PLANING IRON.

The writer of this article, in 1876, attempted some investigation of work-shop processes on the plan of *Babbage's Economy of Manufactures*, but without any knowledge of that book at the time.

The idea, or scheme, was, in its inception, no doubt, the same as that which engaged Mr. Babbage's attention in 1832, when his book was written, that is, a desire to arrive at logical conclusions respecting processes, their nature, adaptation, and, also, why they were done in a particular manner, with more or less uniformity. This search after the genesis, so to speak, of manipulative processes in machine work, was a matter of much difficulty, without precedent or suggestion of others, except Mr. Babbage's book referred to, and without the question having been asked: Why are processes conducted in one manner and not in another?

Among other things the operation of metal planing presented one of the most difficult problems. Why pieces, sometimes weighing many tons, were moved backward and forward in contact with tools that were stationary, in many cases not weighing with their attachments one twentieth part as much as the "piece," was not easy to determine.

To show the line of reasoning then pursued, the following extract from *Work-Shop Manipulation*, 1876, is given:

"Reciprocating tools are divided into those wherein the cutting movement is given to the tools, as in shaping and slotting machines, and machines wherein the cutting movement is given to the material to be planed, as in a common planing machine. Very strangely we find in general practice that machine tools for both the heaviest and the lightest class of work, such as shaping, and butting, operate upon the first principle, while pieces of a medium size are generally planed by being moved in contact with stationary tools.

This problem of whether to move the material or to move the tools in planing, is an old one; both opinion and practice vary to some extent, yet practice is fast settling down into constant rules.

Judged upon theoretical grounds, and leaving out the mechanical conditions of operation, it would be at once conceded that a proper plan would be to move the lightest body; that is, if the tools and their attachments were heavier than the material to be acted upon, then the material should be moved for the cutting action, and *vice versa*. But in practice there are other conditions to be considered more important than a question of the relative weight of reciprocating parts; and it must be remembered that in solving any problem pertaining to machine action, the conditions of operation are to be considered first and have precedence over problems of strain, arrangement, or even the general principles of construction ; that is, the conditions of operating must form a base from which proportions, arrangements, and so on, must be deduced. A standard planing machine, such as is employed for most kinds of work, is arranged with a running platen or carriage, upon which the material is fastened and traversed beneath the cutting tools. The uniformity of arrangement and design in machines of this kind in all countries wherever they are made, must lead to the conclusion that there are substantial reasons for employing running platens instead of giving a cutting movement to the tools.

A planing machine with a running platen occupies nearly twice as much floor space, and requires a frame at least one third longer than if the platen were fixed and the tools performed the cutting movement. The weight which has to be traversed, including the carriage, will, in nearly all cases, exceed what it would be with a tool movement ; so that there must exist some very strong reasons in favor of a moving platen, and I will now attempt to explain, or at least point out some of the more prominent causes which have led to the common arrangement of planing machines.

Strains caused by cutting action. in planing or other machines, fall within and are resisted by the framing ; even when the tools are supported by one frame and the material by another, such frames have to be connected by means of foundations which become a constituent part of the framing in such cases.

Direct action and reaction are equal ; if a force is exerted in any direction there must be an equal force acting in the opposite direction ; a machine must absorb its own strains.

Keeping this in view, and referring to an ordinary planing machine with which the reader is presumed to be familiar, the focal point of the cutting strain is at the edge of the tools, and radiates from this point as from a center to the various parts of the machine frame, and through the joints fixed and movable between the tools and the frame ; to follow back from this cutting point through the mechanism to the frame proper ; first starting with the tool and its supports and going to the main frame ; then starting from the material to be planed, and following back in the other direction, until we reach the point where the strains are absorbed by the main frame, examining the joints which intervene in the two cases, there will appear some reasons for running carriages.

Beginning at the tool there is, first, a clamped joint between the tool and the swing block ; second, a movable pivoted joint between the block and shoe piece ; third, a clamped joint between the shoe piece and the front saddle ; fourth, a moving joint where the front saddle is gibed to the swing or quadrant plate ; fifth, a clamp joint between the quadrant plate and the main saddle ; sixth, a moving joint between the main saddle and the cross head ; seventh, a clamp joint between the cross head and standards ; and eighth, bolted joints between the standards and the main frame ; making in all eight distinct joints between the tool and the frame proper, three moving, four clamped, and one bolted joint.

Starting again from the cutting point, and going the other way from the tool to the frame, there is, first, a clamped and stayed joint between the material and the platen, next, a running joint between the platen and the frame; this is all; one joint that is firm beyond any chance of movement, and a moving joint that is not held by adjustable gibs, but by gravity; a force which acts equally at all times, and is the most reliable means of maintaining a steady contact between moving parts."

The extract is brief and does not include all the points discussed, but is enough to show that there was, at the time, detected some cause, not very plain, why metal planing should be done by a method that controverted what would be arrived at inferentially, by anyone reasoning on the subject. If, for example, a carpenter were to fasten his plane in a vice, and then push the timber over the plane, that would be the same method applied in metal planing.

Conclusions arrived at since 1876, and in the light of much more experience and observation are, that the gravity table now so commonly employed for planing, had its origin: (1) In a common opinion that weight was one of the main elements required in such work; (2) That alignment, or true movement, could not be attained except by gravity joints, that is, joints held in contact by weight; (3) In a misconception of the rigidity of tools supported on projecting brackets when compared with the common standards and cross heads of the platen planing machines; (4) In a belief that a double length machine, one wherein the work moved over twice the length of the cutting stroke, would do better work.

Before proceeding to consider these points in detail, it may be pointed out that "shaping" machines have been, for thirty years or more, a numerous class of implements, and are, in nearly all respects, a controversion of the propositions above given. The tools are supported on slides, and by the rigidity of cutter bars, or rams, of small section, that at every inch of their movement changed in respect to support. The wider, and presumably, the heavier the cutting, the weaker the tool compensation, and the deflection, if any, was in no way controllable because "in the line of the stroke." Shaping machines, although useful implements of wide use, are very unphilosophical in respect to strains, and, as before remarked, a controversion of the principles of the gravity or platen machines, but their convenience was such as to lead to a world wide adoption of such machines, planing transversely, with a limit of stroke not exceeding 18 inches for effective service.

There were also other cases where the gravity carriage had, by the force of circumstances, to be abandoned. In planing marine work, for example, the moving platen, with its enormous loads and resistances, became so obviously unsuited, that a good many "side planing machines" were made, but on the old idea, in so far as a horizontal platen or sole plate on which the work was mounted, and from which were set up frames or housings for supporting and traversing tools.

Such frames or housings were weak, and the invention was one of convenience rather than one of principle. The main part of these side-planing machines was an immense sole plate, the principal function of which seems to be to support the weight of the work, and which is out of all proportion to the tool-supporting elements of the machines. These machines have been adopted in many of the British engineering works, and in one case are applied to heavy cutting in squaring-off armor plates in the works at Sir John Brown & Co., Sheffield, England.

With these exceptions, the platen or carriage machine has held its place for all kinds of work to which it could be applied, and, mainly, under the assumptions named, which will now be considered.

In respect to weight, as an element in metal-cutting processes, it has an obvious influence on tool action if the weight is attached to the cutting tool as well as in the work and its supports, but in so far as planing this is impossible, and in a platen, or work fastened thereto, can have no effect to speak of, even to prevent "digging in," as it is called when tools lead into the iron. This is the fault of the tools or their supports, and hardly ever because the work "rises." In the other plane, horizontally, or in the plane of cutting, the supposed effect of weight is to prevent chatter or rough cutting, which is also a result of flexure in the tool stems or their support, including the cross head, where there is no weight.

The fact is that dead weight is a matter of no importance. It is comparatively, a weak force acting only in one direction, and when compared with the rigidity imparted by bracing, becomes insignificant in machine tools. The small section of one inch square of wrought iron represents a tensile strength equal to 28 tons, and a resistance to crushing of double that amount, so that compensation, or resistance to strains is to be sought in the rigidity of supports, and not in dead weight.

As to alignment or truth of movement, it is with some temerity that observed facts are presented here. It will be a matter of astonishment to those employing platen planing machines, if they will place two long pieces, side by side, on their machines, and, after jointing two edges, turn them together to see if they will fit. The chances are that on any but nearly new machines it will be found that the surfaces are concave, and that the machines are producing a considerable curve. The laws governing the deflection of beams which need not be repeated here, also the greater amount of "moving wear" in the center of a planing machine accounts for such a result, and it will be found whenever true planing is attempted on platen or carriage machines. Long planing machines are usually arranged for "wedging up," so the main frames can be set to compensate for the irregular wear of the platens in the ways.

The facts in respect to platen planing machines were brought out some years ago in San Francisco, when it was attempted to contract for some long planing on tool frames, with a guaranteed limit of accuracy. Only one firm out of a number would undertake the work, and then only because a new machine was available. In some cases, on old machines, the curvature of the platen movement was .005 inches per foot. Professor John E. Sweet is, doubtless, well aware of this kind of wear upon guiding ways when subject to flexure and exposed to continuous pressure by gravity, and for this reason recommends the "overlap" of the moving surfaces for all guides and slides.

The rigidity or strength of tool supports is also a feature of platen planing machines that rests upon a mistaken assumption. It will not be necessary to go over the ordinary mounting, consisting of vertical brackets, which may be nearly inflexible, a cross-head thinned down at both ends and subjected to torsional strains, that is always flexible in a high degree; tool supports projecting outward and downward from the axis of the cross-head. The most practical way of determining this matter is for our readers, as many as are interested, to try an experiment for determining such deflection. This is easily done by preparing a thin staff or rod of pine wood, eight or ten feet long, putting at its end a light angle plate of steel or iron and screwing this plate under one of the tool bolts, or to one of the swivel clamp bolts on the tool box.

When the machine is set at work the outer end of this staff, by its vibrations, will show the deflection of the cross-head, multiplied by the projection of the staff. The result will be a surprise, and especially if the same staff is then applied on an overhang, or side planing machine where the strength of the main frame is directly employed to support the tools.

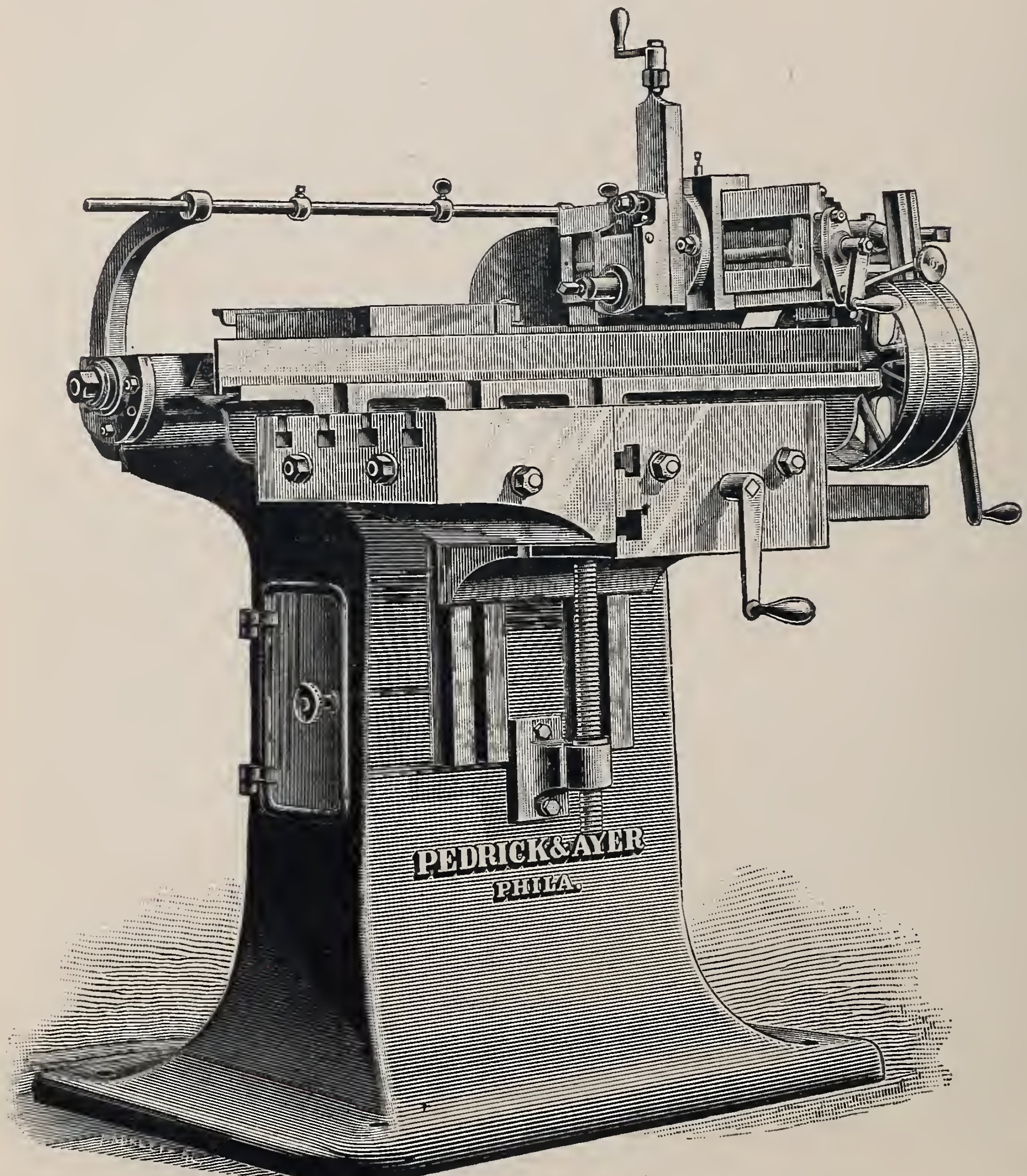


FIG. 2—SIDE PLANING PLANING MACHINE.—12 × 30 INCHES.
BY PEDRICK & AYER, PHILADELPHIA.

On page 14 there is given a drawing of one of these machines, and any one who will analyze the strains of cutting, and their compensation in that case, will soon see that the deflection of the proof rod described will be only the torsion of the strong hollow arm on which the tools are mounted; beyond this, nothing, or next to nothing.

One of the first of these machines made at San Francisco in 1883, was a small one of 20 inches by 6 feet; that is, would plane 20 inches wide and 6 feet long, the depth not being considered, because there is no limit that way. This machine, for a first job, was employed to plane up the parts of a Corliss engine of 100 horse power, and next for a set of engine lathe heads of 8-foot capacity. The machine had to be set up on blocks to get the work beneath the tools.

This method of planing iron has been made the subject of observation for ten years past, not as a mechanical problem, or with any commercial motive, but to observe in it the course of "evolution" in machine tool improvement, and how far exact analysis has to do with the construction and performance of such implements.

The machines themselves are of very simple construction, as may be seen by the small one shown in Fig. 2, which is called a shaping machine, and in respect to which attention is called to the following particulars: first, the length of the machine compared to the length of the work it will plane; second, the weight moved in traversing compared to a platen machine; third, the compensation against flexure of the work, tools, and all parts; fourth, the convenience and accessibility of the work and all parts of the machine. These are all observable or computable quantities, even the deflection under strain, but this, as before suggested, is best proved by a staff or rod fastened to the tool box.

This is not a scientific article and no analysis of these features will be made, but pertinent to them the following facts will have some interest:

In 1885 Luther Wagoner, a well-known engineer of ability, in San Francisco, made an analysis of the sections, strains and compensation in one of these machines, and at the same time of a platen or carriage machine in comparison. Mr. Wagoner is a civil engineer and had not previously given any attention to the functions of these machines, but concluded that weight for weight of the whole machine, the cutting rigidity of the side one, was as two to one. This was proved by the staff test immediately after and confirmed his computations.

It may be explained here, that in some of the machines as at first designed, a great error was made in not providing support for the work itself, as well as for the tools. There was, somehow, an impression that when the work was "still" it could be easily held, but it is obvious that the strain upon the tools and upon the work is equal, both depending for compensation on the same thing - brackets or supports projecting from the main frame.

In some of the first machines made of the larger size, the tool support was at least three times as much as that for the work, not counting the gravity of the latter, which, as before observed, is not worth considering. This fact may have had something to do with a distrust of the system of which we are now speaking.

It required eighteen months of doubt and dread before an English tool making firm could muster up courage to construct such a machine, because they thought it would "spring." It was finally made, and in one day's use there was collected about the machine the key-way cutting, which the other machines of double the size would not do so well, because of "springing," and a month later the firm offered all their platen machines for sale at a heavy discount.

It is a very singular fact that in four years after the first machines were made in San Francisco there were in use in France, twice as many machines as in the United States, and the present product in one works in England is a machine a day.

For this country there are no facts at hand to show how many machines of the kind have been made and sold. No inquiry has been made of the makers as to this, or even of the performance of the machines. It will, however, be made in due course, and at some future time the whole history of the matter will be made up to show how long it requires to bring about a considerable change in any machine tool process that has been established by long precedent.

One thing is sure. The methods of investigation applicable and existing in most other branches of skilled manufacture, are wanting in machine tool making. The remark is not made in respect to planing alone, but in other processes of a more simple kind, and which may have attention in a future article, or articles, in this department.

EXTRACTS FROM A NOTE BOOK.

[BY "TECHNO."]

No. XII.

DOCKS AT MILLWALL——GOTHS AND VANDALS——A SCARCITY OF SOIL——A HOTEL COMMANDER——THE CURIOUS KAKELUNG——A FIRE TO LAST TWENTY-FOUR HOURS——THE RED ANNEX.

———————"Go down," said my uncle, "to the Millwall docks and see which of these Swedish steamers is best, and take passage to Gothenburg." This was to me delightful news. Not that I was tired of London, or had seen more than the crust of it, but because I felt that enough time had been wasted over a hopeless undertaking. The "horizon widens as it approaches." so does this Babylon, and there is no way to know anything of it worth recounting, without living here for years.

I had become expert enough in finding my way. That is easy in London, no matter where you want to go. Millwall docks are on the Isle of Dogs, at the east end, and where the Swedish steamers lie. There are 236 acres of these docks. Like all others they are locked; that is, the gates are opened at high water only. The tides here reach 19 feet sometimes, and there is no such thing as lying at a pier with that variation.

I went down by boat and found two steamers nearly ready to sail, selected the best looking one, "booked" and went back to report.

It costs two guineas for about 600 miles by this direct route, and three guineas via Hull, which is the mail, or main route by water. Of course, quick mail goes by land across the channel, through Belgium and Germany, but not much quicker.

Next morning we went down to the docks by train to embark, and I soon found out that one does not learn all about sea travel in crossing the Atlantic. There were a good many queer things here. The saloon, or cabin, was in charge of a "Mamselle," who had charge of all, and good charge it was. Everything was Swedish. Language, food, customs, and I will add, courtesy, which latter is a very plentiful commodity with these "Svensk" people. They have no such term as "Swedish," or Sweden. It is "Sverige" for the country, and "Svensk" for the people.

My uncle, who has seen much service in the German ocean, was in fine humor, and set out with a lecture on the country while we were waiting for the dock to open.

"Now, Tech," said he, "you will enjoy for a time the relief of not watching your purse. It will be a curious sensation. There is no bargaining to do, and no cheating, so long as you keep under that blue and yellow flag; neither will you be drowned. These skippers are the best in the world, and have to be. I just now said the water would be like a mill pond. So it will up to November, then the North Sea will be a boiling cauldron for four months. I have been nine days making this journey to Gothenburg, standing into the gale, going astern and then running under the land to 'lie to.' Nothing is put on these decks after November. It is the worst sea in the world in winter, unless it be the Baltic, and no one goes there in the winter."

"This vessel is built of Swedish Iron. Run her on a rock or iceberg and she will back out with three stems—one in the middle and one at each side where the plates have doubled in. Run her on the sand and she will lie there all winter. The spars and decks may be hammered out of her, but next spring they will shovel the sand out and pull her off with her frames, skin and main parts all in shape. Fact! Have known it so."

We had a fine passage of 60 hours or so, and entered the mouth of the Gotha River early in the morning. I was "dumfounded" at the appearance of the shores and went down to rout out my uncle. "See any stone or rock about," said he, "if so do not mind that, but look out for soil, and as soon as you see a hatful come and tell me."

The mist was clearing away. On our port side laid the Fortress of Winga. Little islands all about, mainland on the starboard, but of earth not a spoonful. All granite—cold, gray granite. Down in the sea I could discern crags beneath us, how deep I do not know. The water was as clear as light. But the granite!

We entered a river—a fine, wide stream with a strong current, which I mistook for ebb tide, and in five miles more were alongside the granite piers of Gothenburg, pronounced "Yetaborg."

——————In the land of the "Goths and Vandals," the mother of nations, as the French say. Rome was conquered from here; so was most everywhere else, including England at sundry times, and finally by William, Duke of Normandy, another of this same lot. This seafaring, buccaneering, fighting people that had nothing to do and little to eat at home, led the world a merry dance for six centuries or more. They are the colonizing element, and have some part in many modern nations; they are the discoverers of the "majority" inventors of republican government, and of *branvin.*" I am, however, becoming non-technical.

The craft about here are mainly steamers, and the commodities of trade seem to be mainly wood and iron. Thousands of tons of each of these, and one vessel for Japan, loading with matches! Yes, loading with matches, after stowing some tons of "Swedish-bar" at the bottom for ballast.

This is the land of matches. *utan svafvel eller sulfur* (without phosphorous or sulphur.) Matches made of birch, that do not poison or choke one; nice, light matches "made to gauge;" boxes also, uniform throughout. There are 1,500 people in one match factory at Jönköping, and a dozen more factories elsewhere. I well knew the matches before, and had seen them at home by thousands. The British could not imitate them, found their trade injured, and pursued their usual pacific and shrewd plan of "buying out the works." Bryant & May do not make now many matches in East London. They make them in Sweden, at Wennersborg, and elsewhere in the middle section.

A good deal of this I heard from my uncle, who as usual knew all about everything we came across. "The British idea of a match," said he, "whatever that means as a name, is a good stout stick as long as your finger, with a knob of brimstone on the end that suffocates the users and kills the makers. The Swedes are chemists; also mechanics, and found that chlorate of potash was a better fulminate for that purpose. They make matches for the world and will continue to do so, just as they do some other things of the kind, if they do not choke their manufactures by some mistaken commercial polity. Why, there is an armory here, inland 300 miles, making Springfield muskets the same as are made in Springfield, and with the same tools. Just now I happen to know, they have a large order from the Turkish government. They have a cannon factory, or an ordnance works, 400 years old, at Finspong. I have seen it; and at Sandvik there was a Bessemer plant for steel about as soon as Sir Henry got his process perfected. Just sharpen that pencil of yours at both ends. I propose to fill up that book for some pages to come.

These large wooden buildings down along the river there, and one or two on the other side, are wood-work factories, where is made joiner work for London, Paris, Berlin—in short, for everywhere; also finished houses to be taken down, packed and set up again where wanted. You are thinking now of what is called at home a planing mill. Yes, in one sense, but with a difference. Go down there and you will find an architects room. You will find a staff of complete draughtsmen. All the machines will be of the best—all the work too. There will be drawings there from Paris for house work, drawings from Hamburg, Vienna, Berlin, Stockholm—in fact, everywhere, and just outside, in that "red annex," on this side, you will find something with a wonderful meaning, not to be found in the world beside. You will want two pages for that."

My uncle was serious. That "red annex" may require a page or two, but some other things first. We went to the hotel and had a suite of rooms assigned to us—two large and one small one. The ceilings were about 16 feet high, otherwise everything French, or Franco-German in style. The hotel economy seemed to be on the coöperative plan. No one seemed to own or manage it, and the business of the house seemed to be done by the porter, who represented alike the guests and the hotel. He was interpreter, business agent, banker, and more—a general factotum. Whether he ever slept, or if there were "two of him," I could not make out. We had a fire made, and here goes another page on that matter:

——————I was absorbed in the fire making, but my uncle gave it no attention except to say, "Tech, keep a weather eye on the 'kakelung,'" pointing to what I thought was a cupboard. It was about thirty inches wide by two feet the other way, ten to twelve feet high, covered with fine porcelain plates, polished brass doors at the bottom, also at the sides.

The girl who brought the wood opened the lower doors, disclosing a set of inner doors and a flue in the center about twelve inches square. In this she set the wood up on end until the flue was full, and then fired the lot, shut the brass doors and sat down to wait.

In a few minutes the fire was roaring, and in fifteen minutes was burned out. The girl then closed all doors tight, and also a damper at the top, cutting off all draught. That act over, I looked up to to my uncle for explanation.

"You are wondering," said he, "where the effect is coming in. Just wait awhile, and while waiting imagine that bunch of wood burned in an American stove, or in an English grate. That wood contained a certain quantity of heat units. In our country they would all be out of the top of the chimney now. In this case they are all in the room yet, as you will see presently, and will remain here, as you will find further on. What you are observing is concrete common sense, as you will conclude some day."

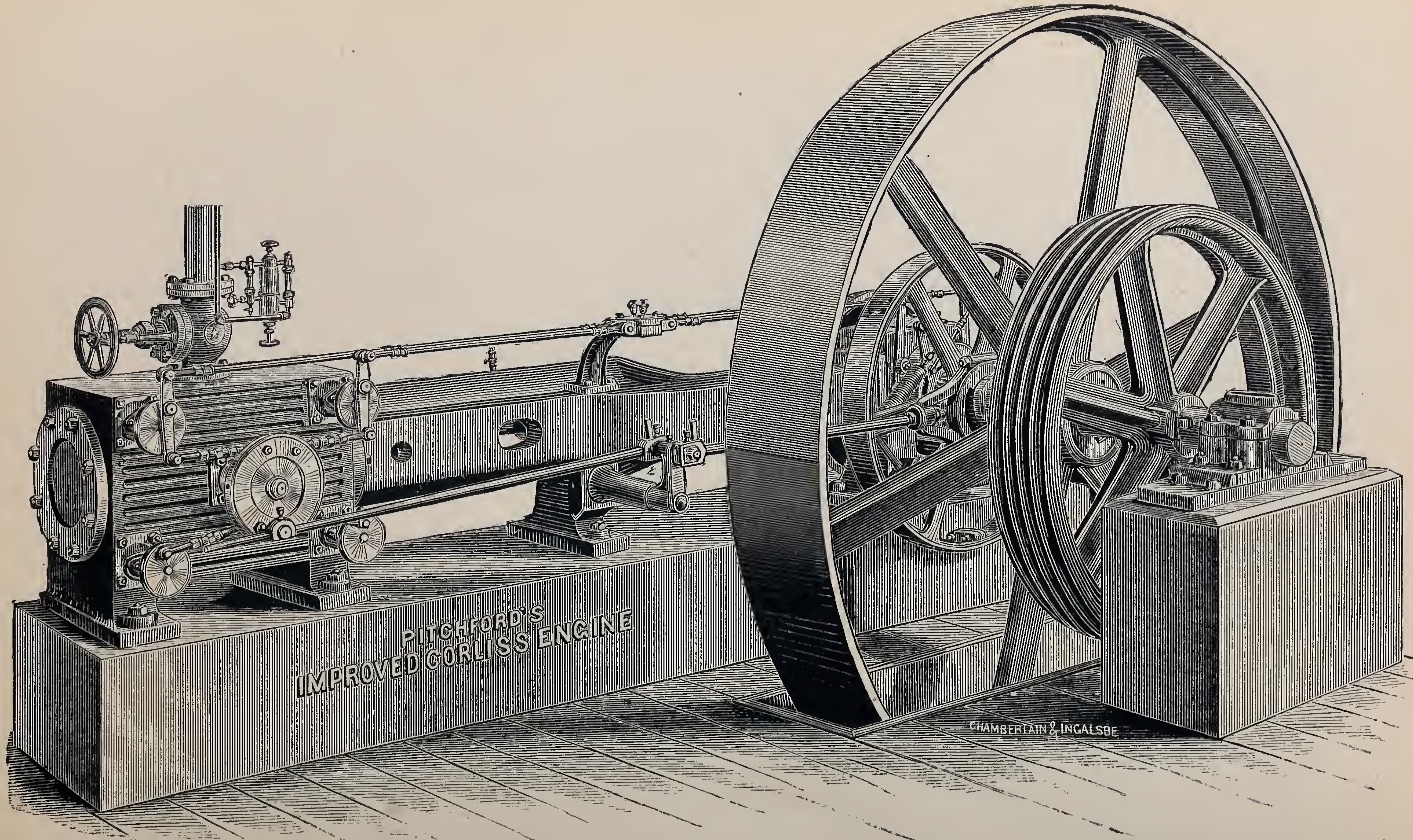
"The flue in that stove is 60 feet long. The heat from that fuel when it escaped was not more than 150 degrees, perhaps not that. You can hold your hand in the flue and there is a little door up there by the damper to see how hot the gases are, by a thermometer. All the heat in that wood is in that stove. It will come out directly, and there will be a fair part of it left there tomorrow."

On examination I found the porcelain plates warm at certain parts and warming elsewhere, and in one hour the whole room had a genial temperature. My uncle showed me how to stow my damp shoes in the side doors of the kakelung (lime-oven), and I am a convert. Let it be written down in the great record of human conceits, that the colder a country is, the less fuel is burned, and that in all these patent contrivances for heating and choking people, in which we excel, there is not one to compare with the common sense Swedish kakelung. Heat here is a commodity, costs money, and is turned on like gas and water. The gauge of loss is ventilation. That too, is a commodity here in Winter, I am told by my uncle ; but our stay will not reach the cold period—at least, I hope not. Salt water frozen eleven feet deep may be a curious thing to see, but I can manage by reading about it.

My uncle says he will give me a start around in the town, and then go out to an island place to seek some old friend of his, while I "do the town," as he calls it. It is not a big town, but is the finest one I have ever seen in many ways. It is principally of granite, built on piles driven into a substratum of mud ; canals of fresh water in the principal streets, and no mean houses at all.

I am curious to know respecting that "red annex," with so much significance. There is something there of importance. My uncle does not joke about such things, but I have not the least idea of what he meant.

(To be Continued.)


PITCHFORD'S
IMPROVED CORLISS ENGINE
CHAMBERLAIN & INGALSBE

PITCHFORD-CORLISS ENGINES.

Whatever concerns Corliss Engines in this country is always a matter of profound interest among steam engineers, and the same remark applies over a wide field in other countries where the Corliss method of valves and regulation has extended.

The part to be ascribed to Mr. Corliss in regulation by cut-off, must be qualified not only by the nature and analysis of mechanism, but on the broader grounds of engine history, commercial as well as technical. It was in 1860, as now remembered, when the writer of this read over a contract made by Corliss and Nightingale, with a New England corporation, in which the firm agreed to operate the works with a third less fuel than had been burned—to receive a portion of the price of the engine when it started successfully, and the remainder in credits for coal saved, until the whole amount was discharged. This of itself was bold steam engineering, even for that day, when the thermal laws that govern steam were not understood as they are now, and there were no "guide posts" for the engineer.

It is a remarkable retrospect, if we glance back over the history of Mr. Corliss' valves and their gearing since that time, and see how little they have varied from his original plans and practice. He, himself, more than any one else, departed from such plans, and it is not too much to claim that he was constrained to conservatism by his imitators.

The claw movements introduced by him ten years or so after the beginning, have given away to the oscillating disc, and the obviously correct functions derived therefrom, so that at this day we find standard Corliss engines varying but little from the original type in so far as the main essential of valve gearing.

The increment of speed in this present time presses hard upon the claw-releasing gearing, and has resulted in lengthening the stroke of Corliss engines to attain piston speed, retaining the releasing gearing of the induction valves by that expedient.

A good many attempts have been made to evade the abrupt release, with springs or other agents for instantly closing the induction valves; one of these designs by Mr. Pitchford, of San Francisco, is illustrated in the drawing on the opposite page.

In this case the induction valves are operated by short levers, the fulcra of which are shifted by an independent eccentric on the main shaft, and by means of the motion rod seen on the top, so as to close the valves suddenly at any point of the stroke. The geometry of this movement, which is easy to arrive at from the drawing, we will not attempt to deal with further than to say that the system has been very successfully applied to engines running at much higher speed than usual. This is, of course, the main object in view. There is no limit in so far as the valve movement, which can be driven at any speed. The engines are made by Messrs. W. T. Garratt & Co., San Francisco.

FRICTION CLUTCHES.

Engineer Hans C. Behr, of this City, came recently into the editor's room and propounded the following question :

"What do the makers of friction clutches mean by giving them a rating by 'horse power' without naming a velocity at which this capacity will apply?"

The question is yet open. It was followed by other questions of equal difficulty, and ended up with a declaration on his part, that the whole of the literature on the subject was worthless to anyone who had such clutches to design.

Mr. Behr's remarks commanded attention because of his well known habit of careful investigation, and also because he had just completed the designs for one of the largest friction clutches that has ever been produced on this Coast, and had, in such designing, evidently ransacked the whole stock of literature bearing on the subject.

The fact is, there is much need of some exact, or, at least, more thorough treatment of this subject of friction clutches, and the varied elements, constructive and otherwise, they involve. Among these are: (1) The endurance of slipping surfaces; (2) the co-efficient of friction, or the power as it is called; (3) the effect of heat generated; (4) the effect of centrifugal force; (5) balancing of both weight and strains; (6) the resistance of engaging and disengaging apparatus, and much more.

Against these can be set down a few rules, such as: A toggle without any driving function is the best means of producing pressure and relieving the same. All strains should be balanced, that is, should apply in two directions to the frictional faces. All parts should balance across the center, in both weight and force. Increment of heat should produce increment of pressure, and alike on all surfaces.

The impediments to friction clutch design are of a constructive kind. Mr. Behr remarked that the mathematics involved, caused him no difficulty, and served only the purpose of disclosing requirements, so the problem is one for those skilled in construction, and acquainted with the phenomena of use. This far, however, with few exceptions, the various forms produced have seemed more a result of search after novelty than meeting the conditions of use.

An exception to this, and one that, for a time, was thought the end of the problem, was the Weston clutch, in which the frictional surfaces were extended or multiplied by area, the pressure remaining constant and assumed at some low or safe unit. These clutches consisted of a series of discs enclosed in a barrel case and capable of lateral adjustment. Each alternate disc was driven by the shaft, which was made of a square section through the clutch, so the discs could not turn upon it, but could slide sidewise. The other set of discs were fastened to the enclosing case, and made with a contour that prevented their turning, so that when pressure was applied at one end, the whole number of discs were pressed together, presumably with equal force, and the driving power as the number of discs or surfaces.

Mr. Weston illustrated his invention by using two books, interlocking their leaves at a number of places. In such an experiment a dozen of leaves interlocked in this manner cannot be drawn out after even slight pressure is applied, but this comparison is not a correct one, because the discs in the clutch have to move "after" there is strain upon them, and offer a resistance to sliding in proportion to the strain. At any rate the clutch has not survived, and is another case where a good theory involved difficult mechanism.

It is not the purpose in this article to discuss the matter, but to call out, if possible, some further treatment of it among the readers of this. To promote such discussion it will be suggested that the most perfect friction clutch, invented to this time,, is a shifting band, or belt, on pulleys of proper size, and running at a proper speed. This, both in theory and practice, has been the most widely applied and the most successful among friction apparatus for stopping and starting machinery.

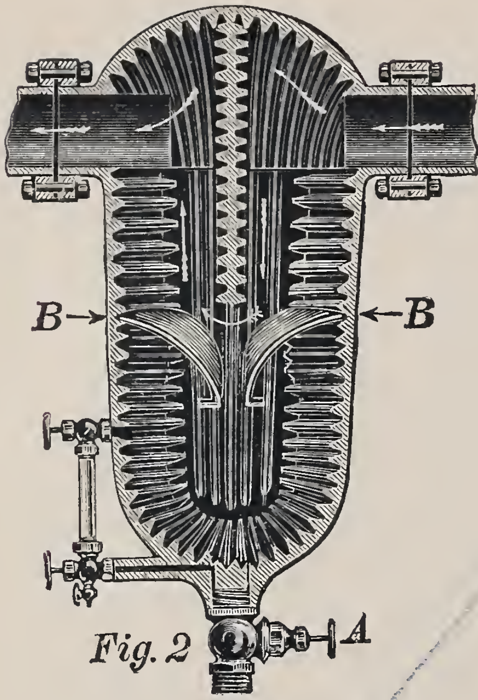
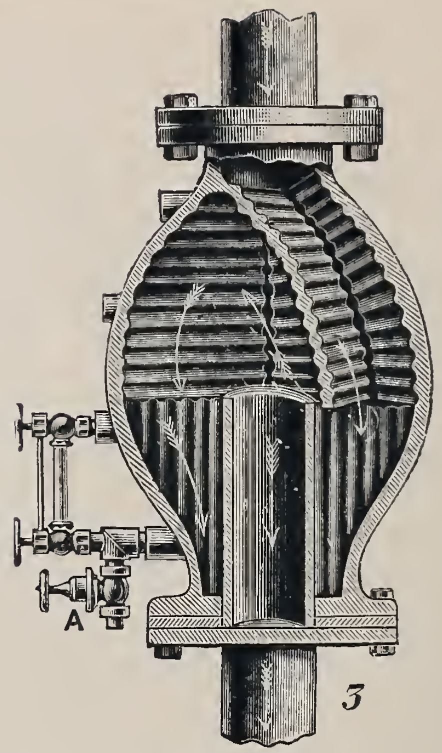


Fig. 2



3

HINE'S STEAM SEPARATORS.

Messrs. Rix & Birrell, of this City, have furnished the steam plant at Stanford University at Palo Alto with a separator for entrained oil or water, such as is shown in the engraving above, called an "eliminator." The performance there seems to be very satisfactory, and explains an extended use of the apparatus in the East. Messrs. Rix & Birrell send the following description :

"Figure 2 represents the recent improved horizontal eliminator, and Figure 3, the one used where the course of steam is downward, and is what is known as the vertical type. The drawings illustrate clearly the functions of this machine and need but little explanation. The exhaust steam impinges upon scattering plates, having sharp corrugated faces, passes to the bottom of the eliminator, and then upward to the engine or heater. The mechanical action will be understood by any engineer. The entrained water, oil and grease pass to the bottom, and are blown off there. These separators are especially adapted for high speed engines.

In the month of June, of last year, Sibley College of the Cornell University, made a competitive test with a view of determining the relative efficiency of various "steam separators," and addressed letters to all the different manufacturers of this country, inviting them to participate. Six of the chief manufacturers responded, and sent their separators for tests, which were exhaustive in character and fully defined the qualities of the different modifications. The present one, called the Hine Eliminator, gave the highest efficiency ; the loss of pressure being less than half a pound, and the efficiency of the separator for the extraction of entrained water was 88.9%

ENGINEERS IN THE NAVY.

The *Engineer*, London, has in its issue of September 11th, a long and thoughtful article on the subject above, full of good suggestion, a plain statement of facts, but lacking in what we call the ethics of the matter. Ethics may not have much to do with steam engineering, but no great change or reform ever came about without having a base in "human relations."

Mr. Carlyle, in his inimitable way, more than twenty years ago, in *Hero Worship*, explained the matter in a manner that leaves nothing more to be said. Some of his sentences contain thought enough for a chapter, or even for a book, and the present is one of that kind:

"The true epic of our time is not arms and the man, but tools and the man; an infinitely wider kind of epic."

This, applied to the subject of naval engineers, means that tools or "implements" must take rank with "arms." The man of tools must rank the doctor, paymaster, navigator and what not, up to the command of a vessel's movements and the supreme direction of its commercial or war functions.

This is assumed because the most important fact in the composition of a modern vessel is her propelling power, also because to understand and control this element is demanded higher scientific and intellectual acquirements than in any other subordinate department.

Taking the time of acquirement and the character of the professional knowledge demanded, which is the only means of fair comparison, the chief engineer will outrank his fellow officers up to the commandant. It may be said that engineers of our day do not possess such qualifications, which is true in a great share of cases, but they must, and will, in future. Nothing can be more certain than this. Their standard has been steadily raised for forty years past, while their rank and pay has been almost stationary.

It is a matter of amazement to go through a war steamer of our day and segregate that portion that comes under the charge and direction of the chief engineer and his corps. It seems to embody the entire active principle of the ship when she is not in action, and even then it is a great and essential part.

The fact is, things move rapidly in the world of science, and very slowly in all social relations. Steam may advance in a year, where its masters may not follow in twenty. This seems the main impediment now to increased rank and pay for naval engineers.

CONSTRUCTIVE MECHANICS.

No. XXII.

MACHINERY KEYS.

Among the topical questions, a list of which has been sent out to the members of the American Association of Mechanical Engineers, is one relating to machine keys. This is to be wondered at in one sense, and to be expected in another sense. To be wondered at because an element so common in all kinds of constructive machine work, should not, long ago, have been settled by some definite rules, generally acknowledged; on the other hand, not wondered at because there is, perhaps, no other problem so often presenting itself without answer, as the dimensions of keys.

At the time of writing this there is, lying within reach, no less than five engineers' and mechanics' reference books, and a search through them shows but one mention of the matter, in "Molesworth." This is a remarkable fact, but not wondered at by the writer, who, in a long experience, has rarely found anyone who had given the subject any attention beyond the immediate requirements of his own practice, or who was conversant with the wide difference between a "strut key" and a "shearing" one; a fixed feather, and a sliding one.

The following data is furnished from personal observation and practice, and is presented as a probable means of drawing out some discussion of the subject in Industry that will include the opinions and experience of others:

Flat Keys—Such as are shown in Figure 1, are commonly made with width equal to one fourth the diameter of shafts, and their depth determined by a parallelogram, the diagonal of which is 30°, as shown at *a*.

These keys, as before explained, drive as struts from their diagonal corners, and require to be well fitted on all sides. They are also depended upon to hold in place

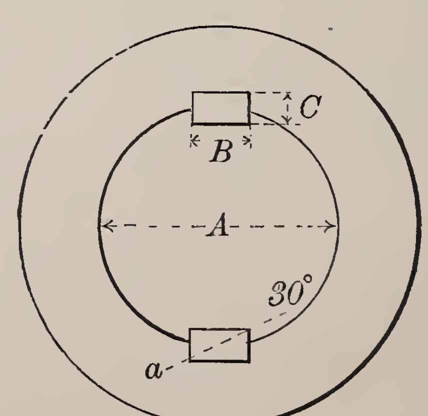


Figure 1.

wheels, pulleys, or other work, consequently must be tapered and fit on the top and bottom. They are apt to spring work and throw it out of true, unless very carefully fitted so as to bear whole length. When employed as wedges to fasten work, they often conceal bad fitting. The following table gives proportions for flat keys :

DIMENSIONS IN INCHES.

A	1	1¼	1½	1¾	2	2½	3	3½	4	5	6	7	8
B	¼	5/16	⅜	7/16	½	⅝	¾	⅞	1	1⅛	1⅜	1½	1¾
C	5/32	3/16	¼	9/32	5/16	⅜	7/16	½	⅝	11/16	13/16	⅞	1

REMARKS.—For shafts larger than those named in the table, there should be two or more keys, the width of which can be one sixth of the shaft's diameter, and the depth by the rule above. Soft cast steel is preferable for small flat keys, so the points can be tempered to prevent upsetting when they are driven out.

FEATHER KEYS.—These are shown in Figure 2. Their section is usually square, or, as the sides alone require planing, it is common to have their width less than the depth. The grooves in shafts should be nine sixteenth of the key's depth. The dimensions are arranged to suit the commercial sizes of steel or iron bars.

DIMENSIONS IN INCHES.

A	1	1¼	1½	1¾	2	2½	3	3½	4
B	5/32	7/32	9/32	11/32	13/32	15/32	17/32	9/16	11/16
C	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	¾

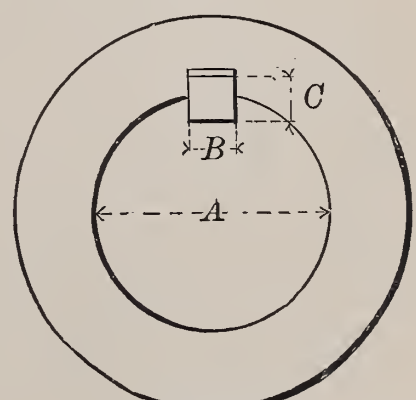


FIGURE 2.

REMARKS.—Keys of this kind should not bear on the top and bottom. When work is keyed on the end of a shaft, a nut is required ; when fastened in this manner, driving fits, or at least good fits, are indispensable, and any imperfect fitting is at once detected. Machine tool makers, as well as makers of fine machinery of all kinds, employ keys of this kind. In some cases, when work is inspected, a thin strip of metal is passed over the keys to be sure there is no bearing at the back.

SLIDING FEATHERS.—This term is applied to keys for sliding bearings, such as the spindles of drilling and boring machines, and other cases where either the shafts or the sleeves move. These feathers being loose in one or the other of the seats, drive the same as feather keys, and are commonly made with the same proportions. This is, however, not good practice, because surfaces with movement require more area than fixed ones, and it is necessary to have surface enough to avoid abrasion. This can, in most cases, be secured by length as well as breadth, but is rarely enough, or even half enough, in common practice. Bearing surface can also be attained by increasing the number of feathers. Figure 3 shows a proper arrangement of two kinds of feathers for sliding bearings.

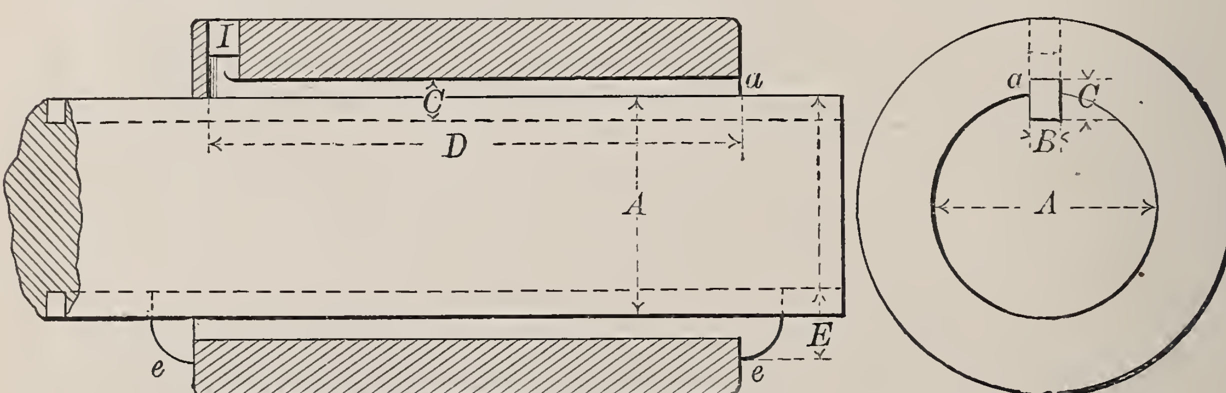


FIG. 3, SLIDING FEATHERS.

DIMENSIONS IN INCHES.

A	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½
B	¼	¼	5/16	5/16	⅜	⅜	½	9/16	9/16	⅝
C	⅜	⅜	7/16	7/16	½	½	⅝	¾	¾	⅞
D	3	3½	4	5	6	7	9	11	13	15
E	½	9/16	⅝	⅝	11/16	¾	⅞	1	1⅛	1¼

REMARKS.—When the boss abuts against collars or bearings, the covered feathers shown at *a* should be used, but if the range is clear, hook heads, as shown at *e*, can be employed, The dimension *D* is not always attainable; the lengths given are maximum, and may be reduced. In cases where there is much strain there should be two feathers instead of one; in extreme cases, three. Two are better than one in all cases, because balancing the strain. The key-way in the shaft should be a little deeper than the one in the shell.

DRAW KEYS.—There is no detail in machine construction more varied than common keys. The form of the head, when made with a hook for drawing, shows at a glance the amount of skill employed in designing, and, if ill proportioned, it mars all that is near it.

The diagram, Figure 4, will furnish some of the principal proportions for key-heads that will not break off. The taper on the top depends on length and various other conditions. It may vary from one eighth to one half inch per foot.

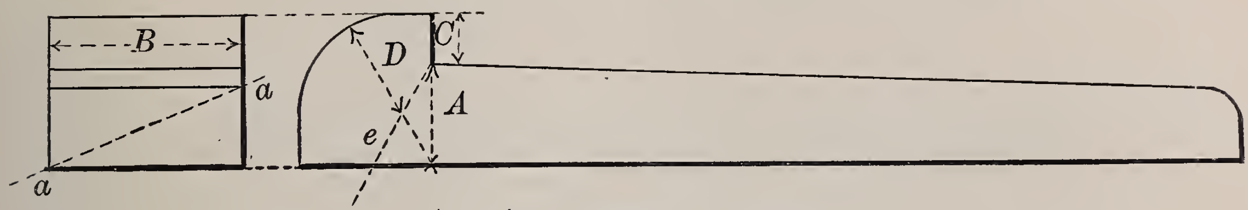


FIG. 4. COMMON KEYS

$A = \frac{5B}{8}$ $B = \frac{8A}{5}$ $C = \frac{A}{2}$ $D = \frac{5B}{8}$

Angle *a*, *a*, = 30 degrees. Taper, ⅛ in. to ½ in. per foot.

SET-SCREWS.—There are very few places where set-screws are suitable for fastening work on shafts; only in the case of light strain, and when the screw heads are shielded. The convenience and cheapness of the method have carried it far beyond its proper place, especially in wood-working machinery. The chief advantage of set-screws is that pulleys or wheels can be fastened at any point on a shaft without cutting key-ways.

A tolerably strong fastening by set-screws can be made in the manner shown in Figure 5, by means of thin flat keys or bearing pieces beneath the screws, resting on a "flat" made on a shaft. This holds against average strain, is not expensive, and the seat can be made after a shaft is in place, and the position of the key determined by experiment.

DIMENSIONS IN INCHES.

A	1¼	1½	1¾	2	2¼	2½	2¾	3
B	⅜	½	½	⅝	⅝	¾	¾	¾
C	⅛	⅛	⅛	3/16	3/16	3/16	¼	¼
D	⅜	½	½	½	⅝	⅝	¾	¾

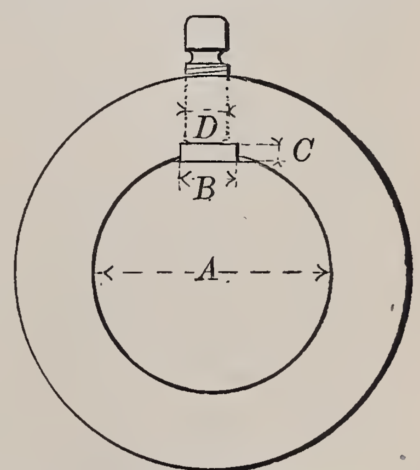


FIG. 5. SET-SCREW FASTENING.

REMARKS.—The keys should be steel, fitted on the edges only, with some space on top, so as to come out easily. This method of fastening causes heavy radial strain on the bosses of wheels; these should be twice the diameter of the shaft.

CONICAL BUSHES.—It is common in England to fasten pulleys in cotton mills with conical bushes, or wedges they may be called, because the shells are split into a number of parts that act like wedges or taper keys. The plan is a very good one, not expensive and does not injure a shaft. There are also other devices for fastening such work, but of exceptional use.

INDICATOR RESEARCH IN PUMPING.

Some time ago there went the rounds a story of Prof. Riedler, of Berlin, respecting his *Indikateur Versuche an Pumpen*, and it was no doubt true. The main points were, that Prof. Riedler, in that devotion to science for which his countrymen are famous, spent about eight years in trying to find out "what takes place inside a water pump." He lavished time, money and health on this object, and when all these were exhausted, he produced his work above named. an "indicator search of pumps or pumping."

This book, which every mechanical engineer in this country should have, is not, so far as we know, translated at this time, but it will be, no doubt, and when it is there will be a fair exposition of sham pumps, that will bring about in other countries as has been done in France and Germany, a "reform of the manufacture."

Not one in a thousand expected, or even conjectured the curious phenomena which Prof. Riedler disclosed in the "*Versuche.*" The diagrams, of which there are about 75 engraved, look like profiles of the Sierra Nevada Mountains, and follow no expected rule whatever.

About all we know of, in a parallel way, were observations made on the extraordinary plant designed by Messrs. Moore and Dickie, of this City, and constructed by the Risdon Iron Works for the Savage Mining Company at Virginia City, Nevada, ten years ago.

This plant, which included steam engines for initial power, was to send down under pressure to a depth of more than 3,000 feet, a column, or "pump rod," of water to operate draining pumps, which in turn forced water back to the tunnel level. The whole plant is no doubt the boldest of the kind ever attempted, considering the risk, the failure of many precedents and the very high pressures that had to be dealt with.

Counting the initial head at which the water was received at 1,000 feet, and the distance to the bottom of the mine at 2,400 feet, the pressure there was 1,475 pounds to an inch, and when the machinery started there began an extraordinary train of phenomena, such as Prof. Riedler found, but intensified beyond anything shown in his work.

Pipes of cast iron three inches thick were blown away like wet paper; not split alone, but "blown out." Pressure gauges indicated tension that had nothing to do with the static head, or with any known condition of moving water against it.

The temperature at the bottom of the mine was 120 degrees, the water nearly scalding, and under these conditions were all experiments and repairs made. For 100 days Mr. Dickie himself was in the mine, up to such point that his powerful physique would permit, and the collected data of one kind or another gathered, would be of much value if given to the world.

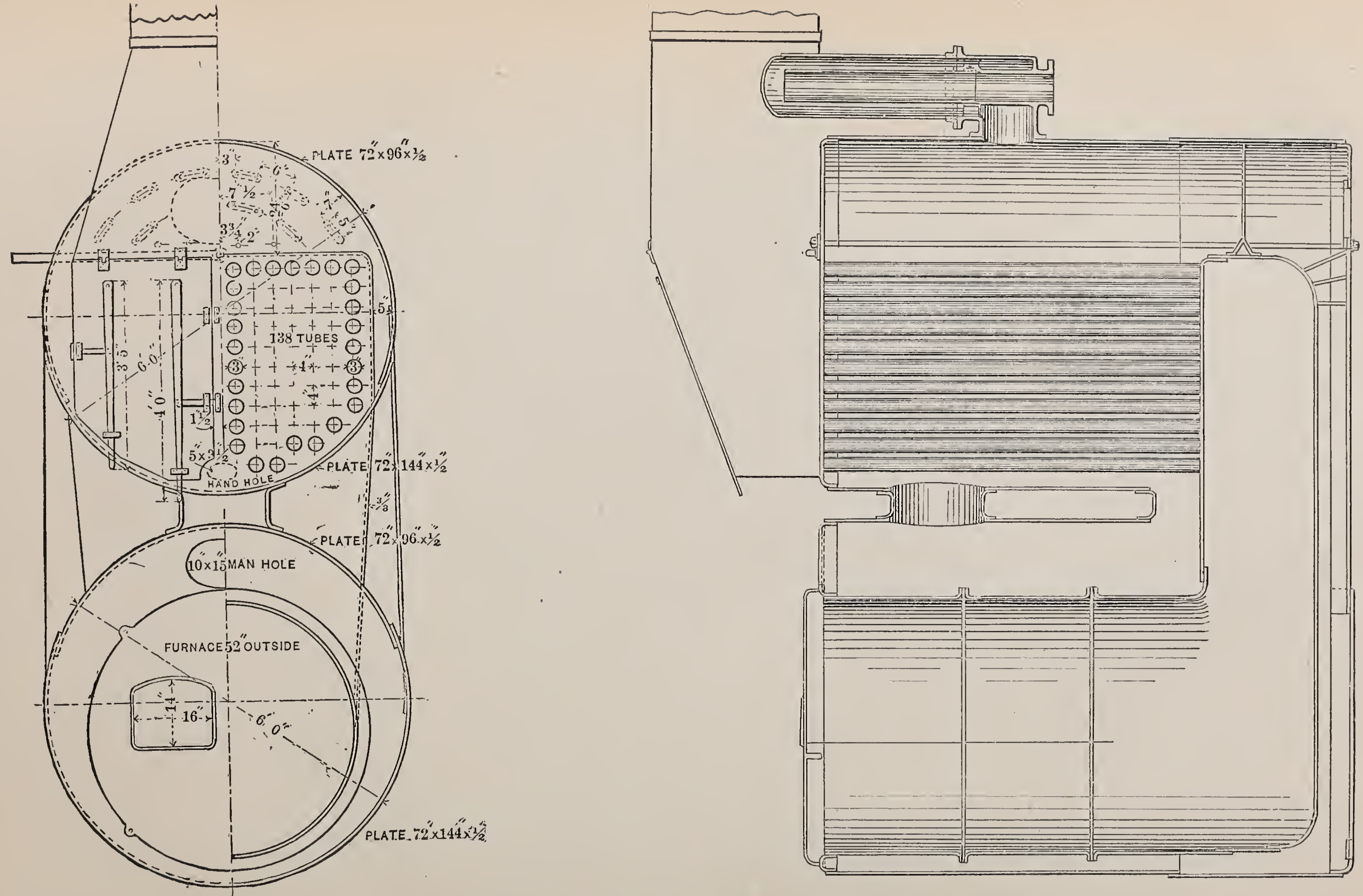
Mr. Eckart, of this City, is also in possession of much information bearing upon this subject of pumping against high heads, and has made numerous observations by means of pressure indicators that, as in the Riedler experiments, show actions of the water wholly unsuspected, and, to some extent, not explainable.

Prof. Riedler, when his work was done, or had been prosecuted to the end of his resources, received an honorable appointment for life in the School of Technology at Berlin, and some recognition of these experiments by California engineers would be a fitting thing.

The purpose of this article is to suggest to anyone who may republish Prof. Riedler's work in this country, that they should include, if possible, the data furnished by deep pumping on the Comstock by water columns, or by water transmission, and is not to convey any information in respect to such pumping, because the phenomena, is, none of it, capable of intelligent treatment, or even remark, except as connected with the "quantities" and circumstances.

Mr. Joseph Moore, formerly Superintendent of the Risdon Iron Works, under whose instructions the high pressure plant was designed, read a paper on the subject in 1886, before an engineering society in Glasgow, Scotland, and so valuable and interesting were the facts considered, that a "special gold medal" was awarded to him for his contribution.

Pumps made on the system of Prof. Riedler can be worked at a piston speed of 300 feet per minute without shock or jar. These improvements relate mainly to "steering" the valves, that is opening and closing them by mechanical means, and not by the stopping or reversing of the water currents, and in designing all ducts with their section corresponding to the velocity of the water; also, for change from one velocity to another in conformance to the well known laws of hydraulics.



Compound Steam Boiler.—P. F. Dundon, San Francisco.

DUNDON'S COMPOUND BOILERS.

A stationary boiler of unusual construction was, in June last, placed in the buildings of Messrs. Huntington, Hopkins & Co., of this City. The Editor of INDUSTRY, who had his attention called to this boiler, applied to Mr. P. F. Dundon, the maker here, for particulars of its construction and performance.

In answer to this inquiry, made some months ago, Mr. Dundon has just sent the longitudinal and end views of the boiler, shown on the opposite page, and also a subjoined communication relating thereto.

Mr. Dundon's claims for his system of stationary boilers are considerable, but are no more than can be expected in the application of a high class, internally fired boiler with ample water and steam rising surface.

The steam dry pipe on top, which Mr. Dundon does not mention, is a feature that contributes to high efficiency, and is, moreover, very simple and effective. Another matter he does not mention is that in the smaller types of his compound boilers they are fire-jacketed, so to speak, so that no masonry is required in erecting them. This communication is, however, confined to the boilers such as are shown in the drawings. Mr. Dundon's letter is as follows:

SAN FRANCISCO, Cal., November 18th, 1891.

TO THE EDITOR OF INDUSTRY:

SIR: I received a letter from you some time since asking for sizes and general data relating to the patent compound boiler which I furnished last June for Huntington, Hopkins & Co's building in this City. I desire to inform you now that I did not wish to write you anything concerning it until I could, at the same time, give a correct and unquestionable statement of results obtained after a fair practical working trial under everyday conditions, and also to satisfy myself as to whether or not this particular boiler would produce results equal to others of the same design, some of which are located too distant to be under my own observation, and, consequently, I had to rely on the statements of others respecting performance. I will first give you, as you ask, the general dimensions, and afterward some careful particulars of results and comparisons.

Referring to the drawings, which I send, the dimensions are as follows:

The lower shell, which contains the furnace, is 72 inches diameter, and the upper shell, which contains the return flues, is also 72 inches diameter. The combustion chamber is 24 feet long by 52 inches wide at the bottom, and 6 feet 4 inches wide at top, and 10 feet high. The furnace is 52 inches diameter and 6 feet 6 inches long, made in three sections, flanged out at the ends of the sections with flanges riveted on to each other, having a caulking ring of 2¼ × ½ inches, Norway iron between. The back end of furnace flanged outward to connect with the tube sheet, thus having no double thickness or rivets on any part of the crown sheet, the upper shell contains 138 tubes 3 inches diameter by 6 feet 6 inches long.

The boiler is made of ½-inch steel, 60,000 pounds tensile strength throughout, except the back, sides and crown of combustion chamber, which is $\frac{7}{16}$ in., and the construction throughout is in accordance with the marine laws, and to comply with United States steamboat inspection. If placed in a steamboat the boiler would be entitled to a certificate for 135 pounds of steam.

As to the results of its workings, I will now speak. I had the boiler all connected in place toward the latter part of July, and it has been in use continuously ever since, except during a few intervals while covering was being put on, and changes in pipe connections made. I have now before me coal accounts paid by the firm over a long period of time when the former Root water-tube boilers were in use. These accounts show a monthly average of $265 for fuel. Taking the month of September for comparison ; the first month in which my new boiler had an uninterrupted run after being completely finished, the cost of coal for that month is only $190, or a saving of more than 30 per cent.

The engineer, who is a capable and intelligent one, informs me that coal consumption with the former boilers was from 2,800 to 3,360 pounds of coal a day with the water-tube boilers, and that he does not, with the new boiler, in any case use more than one ton of 2,240 pounds per day, which amount he expects to reduce in future.

They are using the same quality of coal now as before, and competing at the same rate, and the boiler is supplying steam for all the purposes as heretofore, in fact, all things are unchanged in regard to the consumption of steam. So there is a clear saving of $75 worth of coal per month. This is equal to 30 per cent., not produced by theory or mystifying experiments, but actual reality. The result obtained in this instance corroborates those obtained from similar boilers in other places.

I have received letters from the engineer of the steam tug *Astoria* at Astoria, Oregon, in which he claims that boilers, like these in the drawing, recently supplied to that vessel, are consuming less than one half as much fuel as boilers previously in use had done. I may also, in recommendation of my system for stationary purposes, refer to the Lagrange Laundry Company in this City, where a saving of 40 per cent. in fuel resulted from replacing common tubular boilers with the compound marine type shown in the drawings.

In an experiment made at the latter named place the boilers evaporated 9.7 pounds of water to one pound of Franklin coal. The feed water was 120 degrees, and the steam consumption was too slow in that case to give the best results.

I can refer to many other examples where the high evaporative power of these internally fired boilers has been proved, and although their first cost is necessarily more than for externally fired boilers, the difference is soon made up in the saving of fuel.

For marine purposes I can construct, set up and connect a boiler of the present type much cheaper than is demanded for most other kinds, and will require much less space than is required for the common types.

I also claim that these boilers are more accessible in all parts for renewal or repairs, and that the distribution of heat and also of water is as complete as possible.

Knowing the interest of INDUSTRY in all matters relating to improvements in steam engineering, I send you these statements respecting the boilers you inquire about, which statements can be verified in every way by those having the boilers in use.

Very respectfully, P. F. DUNDON.

THE MECHANICAL ENGINEERS.

Mr. W. R. Eckart, Chairman of the Citizens Board in San Francisco, organized in reference to the proposed meeting of the American Society of Mechanical Engineers, in this city, next spring, has received the following communication from the Secretary of the Society at New York.

W. R. ECKART, San Francisco, Cal.

DEAR SIR: I duly received your telegram of satisfaction at the vote of the Society, and its reading at the meeting was received with applause. The pressure of business after the Convention prevented an earlier reply, and I have in fact, waited until I could communicate positively with you on two or three matters. The result of the canvass of opinion had from the membership showed that we could count on a party of at least 177, able to say positively at that date they would join the party, and from 270 more, replies came that they favored the plan of such meeting and would be able at a later date to say whether they could attend or not. I think we could assume that half this number will be likely to decide in the affirmative. If this expectation is realized, our party would be in the neighborhood of 300, 100 of whom (and perhaps more) would be ladies. The Council has therefore directed the registry of the following resolution, which I forward to you:

"Resolved: That in view of the very favorable expression of opinion by the membership on this matter, the Council accepts with pleasure the invitation to hold the spring meeting of 1892 in the City of San Francisco."

The tone therefore instead of being that of a probability, is one of certainty, and the first steps in arranging the details cannot be taken too soon. It has been decided at our end of the line, that we will put ourselves in the care of Raymond & Whitcomb. We find that by this means very much greater facility and flexibility as to route can be secured than if we attempt to come under our own auspices, to say nothing of the fact that I will be relieved of an enormous amount of detail in the matter of trying to administer the transportation problems. We propose to arrange for several itineraries, the party to divide itself, probably by train-loads, so as to take advantage of the trip which would be most agreeable to the tourists. We will get in a few days, the printed proposition of the tourists' agency, concerning which I will advise with you. * * * *

In the matter of our professional meetings in your city, it would be desirable to provide, in arranging the programme for the week that we should be likely to be in San Francisco, for five sessions. My experience is that such sessions are best in the morning, and that the afternoons are the periods best allotted for visits to professional points of interest, shops, iron works, etc. The evenings can either be devoted to sessions for papers, or to social enjoyments, as the desire of the local membership may indicate.

I take it that we would be likely to arrive on Sunday night. If the first session were set down for Monday night, and the succeeding ones for Tuesday morning, Wednesday morning and evening and Thursday morning, we should be able to get through our business and yet have considerable time that can be allotted for the hospitalities which the enthusiastic welcome of the Pacific Coast seems to delight to promise. I can talk this matter over more intelligently with you when I have the itinerary before me of our agents in the matter of the return journeys. Our return idea had been to come back either directly without stopping, for those who were in haste to get back to regular work, or second, to make the Yosemite stop and return without stopping, or third, to go to Portland and so back without stopping, or fourth, to go to Portland and the Yellowstone, and so home; these return trips to be made in parties according to the time which the various groups could afford to give to their outing. I will advise you of these details later, though I do not know that they are especially necessary to the laying out of the San Francisco plans.

The scheme of a Pacific meeting has been eminently popular, and has been of great benefit to the Society, and I regard it as a most happy inspiration. I trust that at your end of the line it may prove all that you expect."

Very truly,

[Signed.] F. R. HUTTON *Sec'y.*

12 West Thirty-first St. N. Y.
December 3d, 1891.

BOILER MAKING.

At the late meeting of the Institution of Mechanical Engineers in England, a paper was read on the subject of "Lancashire Boilers," and following was a discussion of a good deal of interest. The following is an extract from the remarks of Mr. R. H. Tweddell, the well-known inventor of various hydraulic machines employed in plate working:

"He said, that though not a boiler maker, he had been engaged amongst boiler makers for the last thirty years, and he thought that in the course of that experience he had learned some of the points connected with that branch of engineering. The author had said that the proper angle for planing the plate edges where they are to be butted together and form a close joint, could only be arrived at by experiment. The smaller the diameter of the circle to which the plate is bent, and the greater the thickness of the plate, the sharper will be the angle required; while for larger diameter and thinner plates the edges will require to be planed more nearly square. Mr. Tweddell thought that the author was hardly correct in these statements, and that the correct angle could be arrived at by a simple geometrical problem, whether the circle was large or small, and the plate thick or thin. With regard to caulking, his opinion was that it was an excellent means of undoing work that had already been done, so as to give a job to the boiler mender later on. Mr. Webb, of Crewe, in a previons discussion had said that he fullered with a half-round ended tool, and that, the speaker considered, was the proper mode of procedure, as it did not press the plates apart. He agreed with what had fallen from Mr. Halpin in this respect.

With regard to the pneumatic caulker, the idea was not new, for 15 or 16 years before he had assisted in caulking a boiler by means of a rock drill. That was found a very effective tool for the purpose, but it made a good deal of noise; so much so that it interfered with the ringing of the cathedral bell close by, and the eclesiastical authorities stopped the proceedings. He was of opinion, however, that if boilers were properly made no caulking would be necessary. Mr. Tweddell admired the candor with which one boiler maker had referred to the use of the drift. 'Boiler makers generally express holy horror at the mention of such an iniquitous instrument, but what did the author say? 'In most boiler works use is made of the drift; but where is there a works without it?'

With the material of which the best boilers are now made, there seems no reason why the judicious use of the drift should be at all feared.

These remarks referred to drawing of plates together by the drift, and the author went on to say: 'If a 2-inch strip will stand a ¾-inch hole drifting to 1¼ inches diameter without apparent distress, as so often shown, surely the drift may be trusted for drawing the work together. Not long ago, on the closing of a works, from which the best class of boilers had been turned out, the tools sold were found to include no less than ten hundred weight of steel drifts, which had been used in the boiler shops.' Referring to these passages Mr. Tweddell said that those who well knew the practice in boiler shops were aware that drifts must be used. He had, too, a partiality for the good old punching machine. He knew in that too he was opposed to the modern cult, and boiler makers no more dare to acknowledge to the use of the punching machine than to that of the drift. But why, he would ask, was it that there were so many punching machines seen about boiler shops? They were not ancient enough to be curiosities, and he could only suppose they were retained—like the drunken man at a temperance lecture—as awful examples. The late Dr. Siemens had said punching a plate strengthened it in the neighborhood of the holes, and the process had the advantage of testing the plate in a cheap manner. But even those who drilled the majority of the holes, punched one or two here and there, and if the plate was injured over a large part by a great many holes, would it not be injured over a smaller area by a few holes? A chain was only as strong as its weakest link; and there was this disadvantage, that the weakness would be unsuspected in the case where the majority of the holes were drilled. If they frankly accepted punching the difficulty would be faced and the plates would be annealed when required, but the one or two holes here and there were not annealed."

REPORT OF THE SECRETARY OF WAR FOR 1891.

The most notable portion of Secretary Proctor's Report, now published, relates to the moral rather than the physical features of his administration. A considerable activity in the provisions and material of war, as well as defences, is known and expected, but behind this, and of equal importance, has been some improvement of the morals of the force, described in the following words:

"For the improvement of the enlisted force new methods of recruiting have been adopted. It is carried on more in small towns and rural communities, and the recruits are held on probation and their antecedents carefully inquired into. The ration has been increased by the addition of one pound of vegetables daily. Soldiers are now entitled to a discharge at the end of three years of faithful service, and are permitted to purchase their discharge at any time after one year. Summary courts have been established for the speedy trial of petty offences. If the men desire, competent officers are assigned to defend them before court-martial. Punishments in time of peace, under the articles of war, have been defined and limited. Sunday inspections and tat-too roll-call have been abolished; schools and gymnasia established. These, together with the specific measures undertaken for that purpose, have reduced the percentage of desertions to a lower point than ever before in the history of the army, and in the last year have reduced the number of inmates of our military prisons over twenty per cent.

Desertions from the army from 1867 to 1891 (twenty four and a half years) were 88,475. In 1889, desertions were 11.6 per cent., or one in nine. During the past year the desertions have sunk to half this many, and, as the Secretary hopes, will further sink to two per cent.

His annihilation of the Post Trader, of which there were eighty five at the beginning of his administration, is a most commendable act. The system was a pernicious one; a mere device for favoritism; a kind of protection, distasteful and unjust. These post traders paid no taxes, and had just such privileges as were conferred under the old "statutes of monopoly" that were so vigorously repudiated by our forefathers some centuries ago.

Perhaps no other portion of Secretary Proctor's Report will have more interest to western people than the section relating to the enlistment of Indians. In March last an order was issued for enlisting one company of Indians for each of the twenty-six regiments of troops serving west of the Mississippi. Seven of these companies have been enlisted to a complement, and seven more are being filled up. The Secretary says:

"I have had an opportunity to personally inspect some of these Indian cavalry troops, and have recieved full reports showing the condition of others. In good conduct, drill and military bearing, attention to duty, observance of courtesies, and care of horses, arms and equipment, clothing, barracks, mess rooms and kitchens, they are at least equal to soldiers of other races of no greater experience. For example, Troop L, of the First Cavalry, recruited from the Crow tribe, though none of its members had had more than five months' service, furnished as early as September 14 last its full quota of non-commissioned officers, trumpeters, and privates for guard, fatigue, and other post duties; and on a recent two weeks' practice march of the command to which it belongs demonstrated its capacity for the performance of the various duties of the expedition. The colonel of the First Cavalry recognizes that the men of this troop possess in a high degree the characteristics and traits essential in light cavalry, and considers them a valuable acquisition to his regiment. Satisfactory reports have also been received of the progress of the Indian infantry companies.

This, by itself, is not a great circumstance, but it may mean in the end a solution of the Indian question in so far as removing them from the paternal position that has so long destroyed the independence and confidence of the Indians. Many of their natural traits fit them for military service, especially as cavalry, and, if their own people can become qualified as officers, there will be hope of obedience to discipline, at any rate the experiment is one well worthy of a trial.

In the appendix of the Report is found a list of expenditures for the fiscal year ending June 30th, 1891, from which it appears that the sum of $587,361 is available for pneumatic dynamite guns. This money had as well be transferred to some other fund in so far as hope or promise of useful result in the way of dynamite guns.

Payments for the year amounted to $51,467,133, of which one half was for public works, such as the improvement of rivers and harbors. The Report is brief, concise, and with that of the Secretary of the Navy will be, no doubt, the two to command most confidence among those of the various departments of government.

NEW PISTON ROD PACKING.

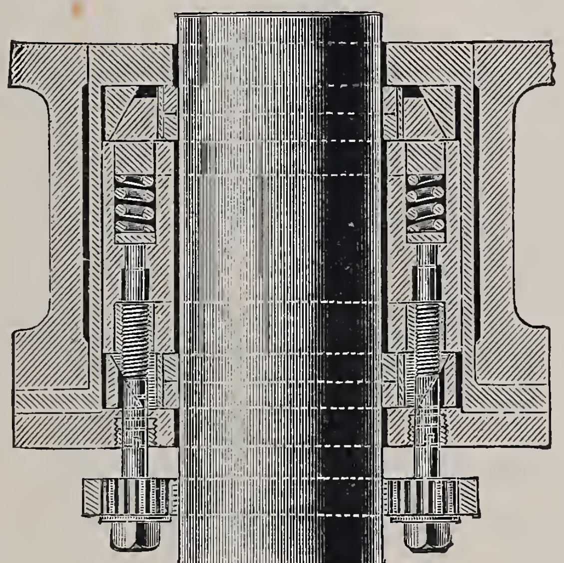
Mr. John B. Houston, of this City, sends the above drawing of a new piston packing that seems to have commendable features, and which has been a subject of recent patents, granted to him in this country and abroad.

No better description of the packing or its new features can be given than the following extract from his patent specification:

"This invention consists in employing two sets of double packing rings, embracing the piston rod at both the outer and inner ends of the stuffing box; behind or surrounding these rings, thin bands or collars, capable of flexure, and outside of these bands, sections of a beveled or wedge ring, operated by screws and still beyond and embracing these wedge sections, a complete ring with corresponding beveled faces, on which fall the strain of compression, independent of the main shell or stuffing box containing the packing.

The invention also includes two flat rings for compressing and adjusting the sections of a wedge ring, before named, these flat rings being operated by screws which press uniformly and dependently upon them, producing like compression of the packing at each end of the stuffing box. Such screws being multiple and connected together by means of tooth gearing, the adjustment will be uniform and equal, not only in respect to the compression of the packing at both ends, but also in respect to all sides of the piston rod.

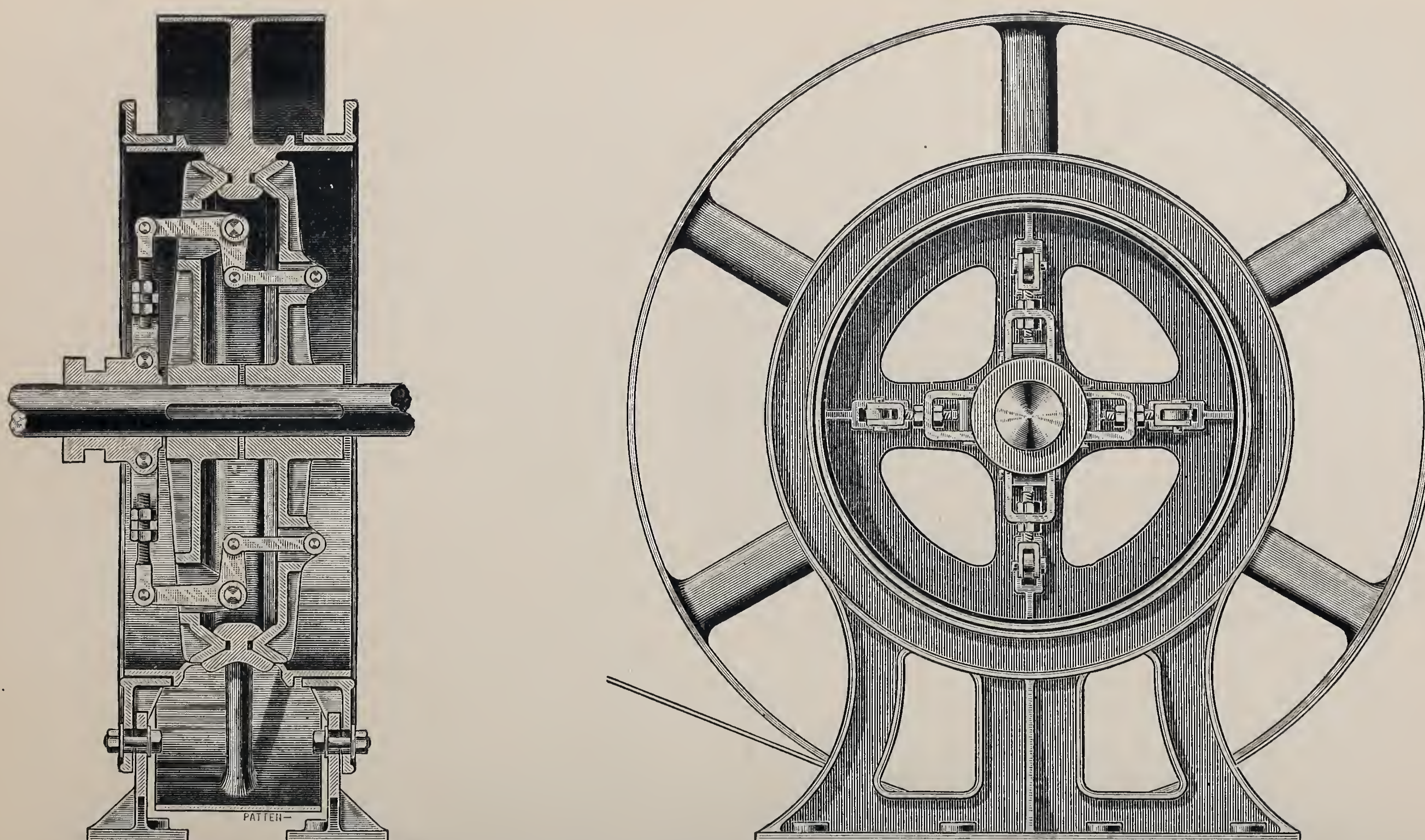
The invention also consists in the employment of a collar, or distance piece between the two sets of packing rings, at the outer and inner ends of the stuffing box, in which collar or distance piece, the flat rings before named are imbedded, and the ends of which have a ground fit against the packing, so as to permit, when required, lateral adjustment of the packing as a whole, without any leak of steam or other fluid."



The drawing shows a true section, and is sufficiently clear to be understood without further description than is quoted above.

The employment of packing rings at two points, interdependent in respect to pressure and adjustment, seems to be a novel method, especially as this end is attained without interference with the "floating," or latteral movement, to accommodate the deviation of a rod. The arrangement also gives to the outer packing ring the advantage of moisture collected in the intermediate chamber between the two sets of rings.

There is evidently a good deal to be learned yet respecting the retention of steam by moving joints, internally, as in the case of pistons and valves, where leaks are not visible. Practice has settled down to a few simple methods instead of more elaborate ones that had preceded; but in exposed or outside packing, there is room for much wider application, especially around rods and stems, that are now commonly fitted with fibrous packings.



Christie's Friction Clutches.—Fulton Iron Works, S. F.

CHRISTIE'S FRICTION CLUTCHES.

In the editorial section of this issue some comment is made on the discussion at the late meeting of the American Society of Mechanical Engineers in New York, on friction clutches, in which discussion it seemed that no one was aware of that type which has no running bearings when out of use. As a coincidence, Mr. H. P. Christie, of this City, who has given much study to such clutches, and is the inventor of several successful types, has sent in the drawing on the page opposite, which shows one of the latest modifications made under his patents, by the Fulton Iron Works of this City, where he is connected.

A modification formerly used to a wide extent on this Coast, and having nearly similar functions, was illustrated and described in INDUSTRY No. 5, of December, 1888, but the present form has structural and operative advantages which have led to its adoption in all cases where such clutches are required.

In explanation of these friction clutches, no better description of their principle, or mode of operating, can be given than that found in Mr. Christie's patent specification, which is quoted accordingly:

"My invention relates to that class of mill gearing wherein wheels or pulleys are engaged and disengaged by means of frictional contact, and to a method of supporting and maintaining in alignment such pulleys and wheels when they are not in motion, or use, without any running joints or bearings, when the frictional surfaces are disengaged; also, to increasing the area of such surfaces, and balancing the strains thereon.

The invention consists in providing at both sides of pulleys or wheels annular supports or bearings, the diameter of which is great enough to permit the friction clutch mechanism to pass through the bearings, and to operate therein; the wheels or pulleys having no support on, and consequently no connection with, the driving or driven shaft, except through the medium of the friction clutch, when that is engaged.

It also consists in providing the wheels or pulleys with rims or extensions at their sides, projecting beyond their faces, so as to form an axial bearing, or support, when the wheels or pulleys are not in use, such support being, as before said, independent of the driving or driven shaft, to which the friction clutch is applied."

Our skilled readers will find no difficulty in tracing out the construction of the clutches from the drawings, which are in true elevation and to scale. The idea, so to speak, is that of surrounding the clutch mechanism with an annular bearing, or bearings, that substitute the shaft when the pulley stops, or when the clutch is disengaged, so there are no running bearings to maintain and lubricate. It may also be noted that all strains, gripping, centrifugal and locking, are balanced and equal.

Other modifications adapted for coupling and disconnecting the ends of shafts, and special machinery of various kinds, are made under Mr. Christie's patents. These we expect to illustrate in an early issue of INDUSTRY.

LUBRICANT BEARINGS.

The Journal of the Franklin Institute, for December, contains a report of the Committee on Science and the Arts, on what are called "lubricant bearings" invented by Mr. Philip H. Holmes, recommending the award to him of the Elliott Cresson gold medal.

This distinction and the indorsement of the committee indicate an invention of some importance, and one that is capable of very wide application. The report of the committee is, with some immaterial omissions, reproduced here, and our readers are recommended to investigate the matter farther.

The committee report :

"That this invention aims to furnish a new composition of materials to be used in machinery as journal bearings, packings for sliding surfaces, etc., which possesses the requisite hardness to withstand the usual pressures, and also to offer a surface that, without the aid of oil or other lubricants, will reduce friction to a minimum, and preclude the possibility of excessive or dangerous heating.

The principal element of this composition is graphite, reduced to a fine powder and freed as far as possible from all gritty matter.

To render this plastic and cohesive it is mixed with wet wood pulp, in proportions according with the purpose of the finished article. In this condition the mass is forced into moulds of the desired shape, which latter are provided with ample drainage outlets to permit the escape of the water when the mass is subjected to pressure.

The wood fibre acts as an entangling and straining material to retain the fine graphite and prevent its escape with the water through the perforations of the mould.

After the composition has sustained the requisite pressure in the mould, it is removed and thoroughly dried, then it is immersed in a bath of hot drying oil until saturated, and thereafter baked in an oven until sufficiently dried.

The finished material has thus attained solidity and strength, and when reinforced by metallic support is capable of withstanding heavy pressure, and becomes a safe and efficient anti-friction bearing for general use.

The uses to which this bearing material may be put are so very extensive that it is manifestly impossible for your committee to make extensive tests in every direction to prove its efficiency, but so good an exhibit of its application has been afforded us that safe conclusions may be drawn therefrom regarding its merits, in a range of mechanical uses covering a wide field. * * * * *

The well known property of graphite as a lubricant has encouraged many attempts to so combine it with other materials that it might be used as a complete substitute for metal bearings, but up to the present time no one of these, save that of Mr. Holmes, has succeeded to the extent of securing even a limited adoption.

All prior inventors have incorporated in their product some unsuitable, and not infrequently some antagonistic material, which, upon trial, has caused the defeat of the object and consequent abandonment of the article.

This, however, does not apply to Mr. Holmes' efforts, for the two chief elements of his composition are both superior anti-friction materials, and the third (drying-oil) while aiding to strongly unite the other two does not appreciably decrease their anti-friction value. Again, in the Holmes compound there is nothing that any degree of heat that can arise from frictional causes can injure, or by any possibility cause surrounding objects to ignite ; therefore, the fire-risk, due to the over-heating of journals, will disappear in direct proportion to the use of these graphite bearings.

We find further that the ratio of friction with the Holmes bearings is much less than with well oiled metal bearings, and greatly superior to the results obtained in common practice, thereby effecting a great saving in power even in comparison with the most carefully attended metal bearings. The coëfficient of friction of the Holmes bearing is practically constant, being no greater at starting than when running at any speed, which cannot be said of oiled metal bearings.

This material may be moulded into any desired form with the nicest accuracy of finish, so that all forms may be infinitely duplicated with standard precision, without the necessity of touching a tool to them.

The remarkable qualities of this bearing material are strikingly exhibited in its application to the spinning frame, when the spindles are run at very high velocities. In this direction your committee have taken special pains to verify, by personal tests, the excellent results vouched for by others. Spindles running with unusually tight belts constantly ten hours a day for three weeks, at a speed of 8,400 revolutions per minute, did not heat or show any perceptible wear either of the spindle or the graphite bearings.

Thus, through Mr. Holmes' invention, it has become practicable to run an entire spinning plant without using a single oiled bearing, which realizes in economy, cleanliness and freedom from fire risks, conditions of inestimable value. Your committee have also practically tested the brushes made of this material for use upon dynamos, and found them practically indestructable, that they do not wear the commutators, and give most satisfactory results in every way.

Careful inspection of many bearings, which have been running throughout the day for several months, show, in no single instance, any appreciable wear either of journal or bearing, which fact is also abundantly testified to by others whose observations have extended over one and two years in practical tests, showing the durability of these bearings to be very great.

All of the materials used in the Holmes composition are inexpensive, are obtainable in the open market, and their source of supply in the United States is practically inexhaustable.

These facts remove all doubt of the permanency of supply of this composition where its manufacture has once begun, and are also a safe guaranty of successful and economical production.

Your committee are not prepared at this time to set any limit to the usefulness of this graphite bearing, or to express an opinion regarding the ultimate weight per square inch of surface that may safely be applied to it, but are satisfied that the limit, if found at all, will only apply to such bearings as are essential to the very heaviest class of work, and which constitute only a very small part of the immense aggregate of machines and implements to be benefited thereby.

For these considerations we cheerfully accord to Mr. Philip H. Holmes, the inventor of this compound for journal bearings, and of its practical method of manufacture and application, the well-earned credit of having conceived and worked out to a high degree of excellence an improvement of rare importance and very great value, affecting almost the entire system of machinery construction in the directions of economy of power, extended durability, immunity from fire caused by friction and extreme cleanliness, and contributing substantially to precision of operation and the increase in quality and quantity of product.

This achievement entitles the inventor to the fullest recognition by the Franklin Institute, and to receive its highest award, the Elliott Cresson Gold Metal, which accordingly is respectfully recommended by the committe.

FLYING MACHINES.

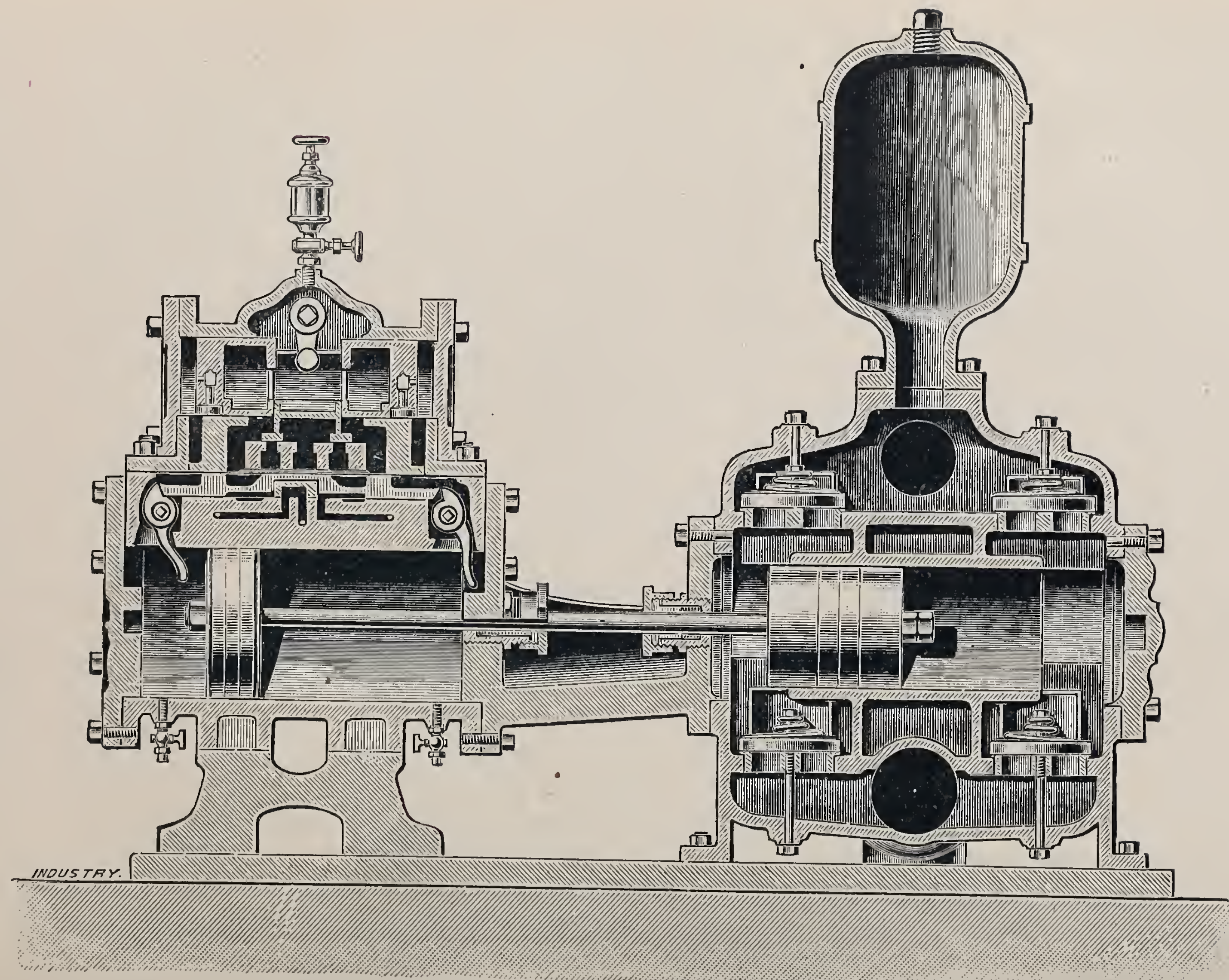
The *Steamship*, in commenting upon Mr. Hiram Maxim's flying ship, or machine, says: That he has attained one horse power for every one hundred pounds of dead weight, but does not mention the amount of fuel this estimate includes. At this rate there is no doubt that a machine of the kind will sustain and propel itself, but what then—is the problem? What is to be done with it? No one is likely to travel in the air under any circumstances. It is dangerous enough on land and water, without adding a risk of dropping, in the case of derangement, or accident to machinery.

Mr. Maxim's experiments have much interest and value, and it is proposed in our next issue to further notice them. They deal with a branch of mechanics that has never been investigated before in a practical way by a practical man, and the main good of his experiments will appear in deterring incompetent people from contriving such apparatus in future.

Such things will continue to be made, no doubt, by people not conversant with the laws of forces, or the nature and possibilities of mechanism, but the scientific world will be done with the matter.

Until the publication of President Chanute's late paper, and some others on the subject, very few suspected that so many contrivances for human flight had been conceived of and made, but among them all there seems to be only one object—to fly. The ultimate, or utilitarian end, has not much concerned the contrivers. We do not say inventors, because the subject scarcely admits of invention. To argue that air and other resistances are insurmountable impediments to the commercial uses of aerial machines, is only a waste of words, so long as commercial use is not a part of the contrivers' schemes. To point out that a weight can be "rolled" on iron ways at an equal speed, and does not require "sustaining" by power, is simple enough, and true enough, but people look at the flight of birds, and doubt.

With our imperfect knowledge of the mechanism of animal flight, and of the forces that are called into play in such phenomena, it is hard to combat the conception of human flight, derived from analogy. All must admit occult causes in the flight of birds, and that is a dangerous admission in dealing with unskilled people.



SECTION THROUGH A HOOKER PUMP.—W. T. GARRATT & CO. S. F.

SECTION THROUGH A HOOKER PUMP.

The drawing opposite is furnished by Messrs. W. T. Garratt & Co., San Francisco, and will serve as nearly as a drawing can, to explain the action of direct-acting steam pumps having what are called steam moved valves. The unskilled idea of such pumps is that their valves can be moved by some direct connection with the main steam, or water pistons. This is inferred from a common steam engine having its valves moved by connection with the crank shaft, but there is a difference. A steam engine has a fly-wheel, and a portion of the revolution is made by the momentum of the wheel, independent of either the force or movement of the engine piston. It is during this part of the time or revolution that the valves are moved, so it may be said the valves are actuated by an independent power or agent, set in motion by the piston, and acting after it stops.

In the case of a direct-acting pump, that is, one without a fly-wheel or any rotary parts, it is impossible that the engine should operate its own valves. For example, suppose the valves thus connected are being closed; as soon as steam is shut off, the piston stops, and there is no movement to again open the valves.

To overcome this impediment there has been a number of inventions, some of them of great ingenuity. One of the first was to provide a "let go" movement of the water piston, just at the point where the valves were to be moved. A communication was opened in front of the piston so as to relieve it from pressure, the water escaping free, while the piston "jumped" suddenly forward, enough to perform the valve movement, or reverse it for the other stroke.

Another method was to compress a spring, or raise a weight, and thus accumulate power which would act to move the engine valve after the piston stopped. This was a very simple method, developed in a good many forms, and now employed to some extent for direct-acting pumps, but the most successful method of all has been by what is called steam-moved valves. This modification is divided into two classes. One called duplex pumps, consisting of two separate pumps and engines, one moving the valves of the other, reciprocally. This was a very successful and simple method that, however, came into use later than the class to which the pump illustrated belongs.

In these there are also two engines, but one of them, the small one at the top, has no other function than to move the main valve of the large, or working engine, and is, consequently, quite small. In the main cylinder is seen two swinging tappets, against which the piston strikes at the ends of its stroke. These tappets move the long bar between them, which is the slide valve for the small engine at the top. This small engine with a long piston, is connected directly to the main slide valve beneath it, the one that distributes steam to the main piston. In this manner the main piston moves the valves of an auxiliary or independent piston, and that, in turn moves the valves of the main piston, after it stops, or is on the center.

In the class called duplex pumps this second or auxiliary piston is amplified into a second pumping engine, not only performing the valve moving function for the first piston, but also the same amount of work. The principle is quite the same, and is, essentially, employing two engines, one moving the steam valves of the other, reciprocally.

NIAGARA HYDRAULIC PLANTS.

Power, in a late issue, gives some account of the Ferranti scheme of utilizing the Falls of Niagara on the Canadian side, and publishes a diagram of the proposed method, which is substantially the same as the one presented by the Pelton Water Wheel Company before the Commission in London, for the American side. Mr. Ferranti seems to understand jet tangential water wheels much better than most engineers at the East, or in Europe even, and in their adoption on the plans proposed will have the important advantage of being able to complete and put into use sections, or units, of a power plant without having to wait for the construction of a long tunnel, and other general work of the kind. In the Pelton Water Wheel Company's estimate, irrespective of the waste tunnel, the cost of construction divided by the horse power showed a very low first cost of plant, lower indeed than any case that can be referred to where any large hydraulic plant has been erected.

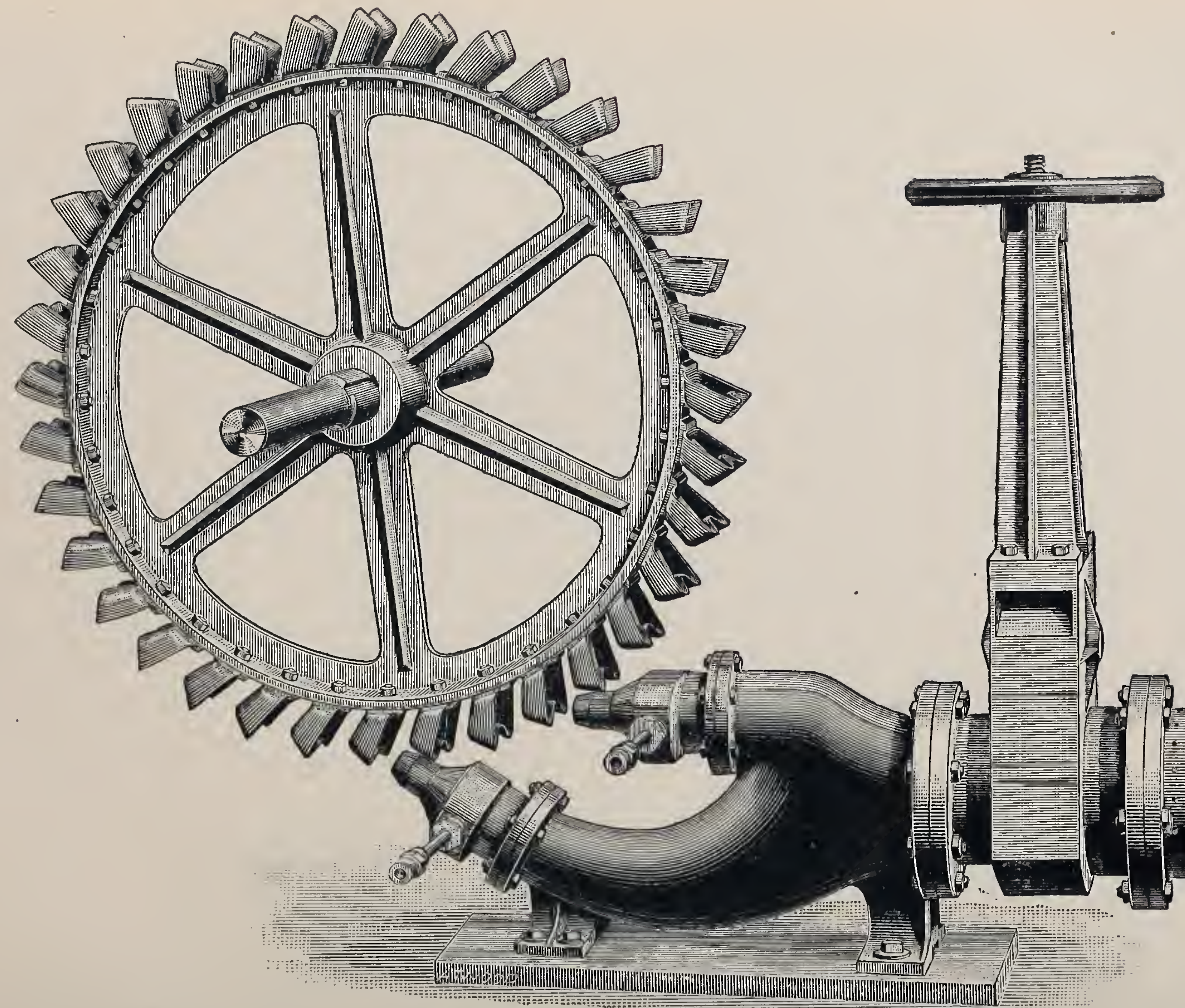
Mr. Ferranti's plan is to sink shafts near to the face of the cliff, and excavate at the bottom, chambers to contain the wheels and dynamos, with short waste tunnels for the escape of the tail water, so that a short time and a moderate investment, will serve until some returns are made for power or light sold.

This Ferranti enterprise, a year ago, seemed on the point of consummation, and as it had no land speculation tail to it, like the one on the American side, but proposed an investment based on fair earnings, there seemed no reason why it should not have preference over a good many other enterprises of the kind that have commanded capital abroad.

Mr. Ferranti's resignation from the Great London Company, at Deptford, and the consequent doubt thrown over his bold operations there, has, no doubt, retarded the Niagara matter, but as we go on it becomes more apparent that the method of high voltage, which was the distinguishing feature of the system at Deptford, was only an early advance in the right direction. There is not much doubt also that Mr. Ferranti in his enterprises meets with the opposition, covertly, if not openly, of the great Siemens firm, at London, and every one knows how sensitive is money investment in the face of opposition of this kind.

The scheme on the American side at Niagara, is a broader one, perhaps a better one, but has had the disadvantage of chromatic circulars in advance of real work, an almost meaningless commission in London, with other "fireworks" that may, in the end, defeat the very purpose intended, that is, to secure capital to put down the plant and convey power. That much value will attach to the competitive plans sent in by engineers in Europe is possible, and is nothing more. Any single "section" or unit of the proposed power plant considered by itself is of no more importance and has no more intricacy than other plants now existing, and in constructing one such section it would have been much better to have employed competent designing and consulting engineers, and gone to work. It may be better to sell land and contract for power in advance, but a Company whose plans include only the generating of power and its conveyance by wires, can predicate with a good deal more certainty what the profits are to be. Electrical energy has now become a commodity of tolerably fixed values, both for lighting and power purposes, and perhaps the most salable of all commodities unless it be food, fuel and water, so there is little risk in its manufacture.

The zone of consumption around Niagara is perhaps the best that could be selected in this country, and there is no lack of a market within the limits of electrical transmission under the high voltage system, so that any failure to complete the schemes on either the American or Canadian sides must be due to some cause in management and methods, instead of the commercial conditions involved.



Double Nozzle for Tangential Water Wheels.

DOUBLE NOZZLE FOR WATER WHEELS.

The Pacific Iron Works, in this City, furnish the drawing on the opposite page, of a recently designed double nozzle for tangential water wheels, constructed as nearly as possible to provide for the acceleration of approach, and also for application of the streams in such relation that they do not interfere one with the other. There is also the provision of independent control for each nozzle besides the common gate in the main supply pipe. For the rest the drawing needs no explanation, showing as it does all parts clearly, and in correct proportion.

DRAINING HAARLEM LAKE.

Almost everyone has heard something of draining Haarlem Lake This great feat, carried out something more than twenty years ago, was one of the most remarkable, as well as by far the most extensive of its kind ever attempted.

This inland sea, near Amsterdam, in Holland, was sixteen miles long, eight miles wide, and of a very uniform depth of twelve feet It contained about 45,000 acres of area, which has been converted into the richest farming land in Holland. The area drained was not as large as the Ferrara marshes near Rome, in Italy, but the volume of water was more.

The lake was surrounded by a dyke, or embankment, made in the usual way in Holland, with "mats" or rafts of willow twigs to hold the earth, an expedient adopted because of the want of timber and stone in that country, but, perhaps, after all, the most scientific means ever discovered of combining and confining earth against the erosive action of water.

These willow mats, or mattresses, are employed for dams, dykes, roads and foundations, not only in Holland, for since their discovery there the same method has been adopted in other countries. Captain Eads, in deflecting the waters at the mouth of the Mississippi, in his great jetty system, employed the willow mattress system. Huge rafts were made of twigs or brush, loaded with stone and sunk to the bottom of the river, where they remained to catch the silt and become solid.

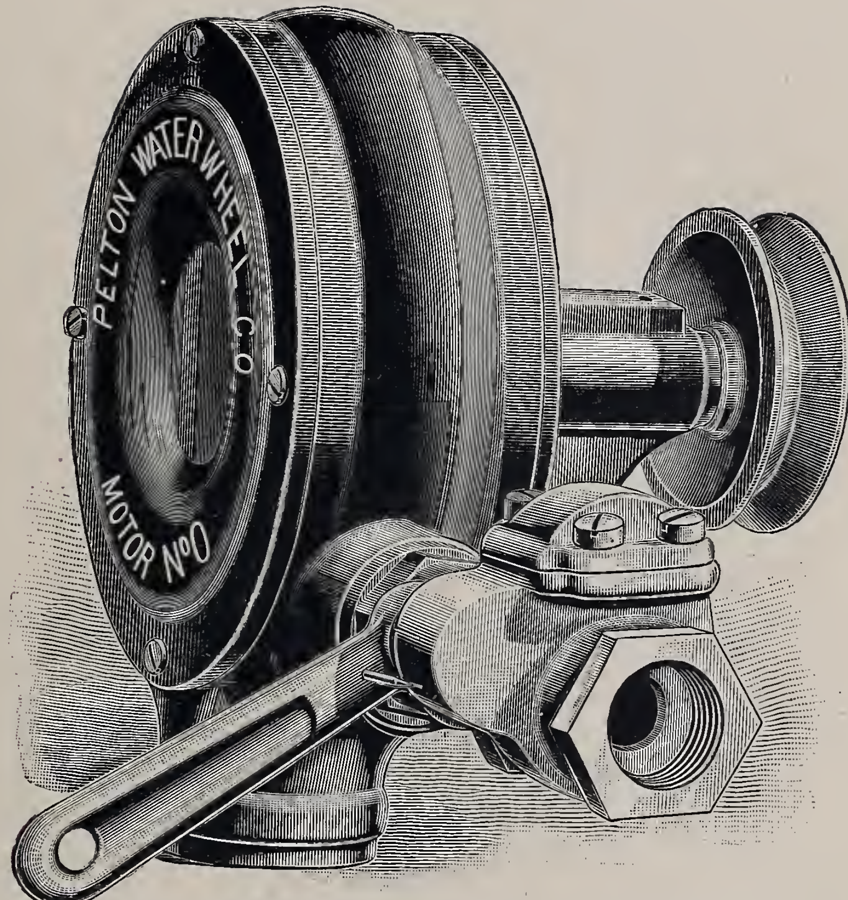
There is no doubt that here, in California, there are many cases where this method is suitable, especially as willow brush is plenty, and the alluvial material hard to confine or hold.

Returning to Lake Haarlem, the Dutch government, after deciding to drain the lake, had to make extensive works to dispose of water emptying into it, from numerous canals for draining the country around. Three powerful pumping plants were erected for that purpose. A canal 300 feet wide was made all around the lake, and the pumping began by means of steam power. Twenty-eight pumps raised 336,000 gallons a minute, fifteen feet high, and the lake soon became a *polder*. As the dry land began to appear, rows of willow mats were placed to form the banks of canals, and also dry roads which were made on the tops of the embankments.

The banks or dykes, which also constituted divisions of the land into sections, were formed of alternate layers of mats and mud, with a layer of gravel on top to form a road bed, and, as before said, canals, which, in Holland, are as common and necessary as the roads. There were fifty miles of canal and a hundred miles of road thus made in the *polder*, separating it into divisions or farms like the squares in a city. This great work has been supplemented by the draining of the Zuyder Zee, another large lake, only a few years ago, by methods much cheaper and more effective, centrifugal pumps being employed for raising the water.

The Haarlem scheme was, however, the remarkable one, considering the want of precedents and less perfect means then known of carrying out so difficult an undertaking.

Whenever the sedimentary lands along the San Joaquin and Sacramento Rivers have a value equal to the *polders* in Holland, such lands will, no doubt, be drained and dyked as those of the Netherlands. It is evident, however, that dykes and other works to reclaim land in California, will not succeed without some means of arresting the building up of sedimentary lands. The scour of the rivers must remain fixed and sufficient to carry off the vast amount of matter coming into the valleys, otherwise, as at various islands in the Sacramento valley that have been reclaimed, the cultivated land will soon be below the river level. This result comes from two causes; the raising of the river level, and the sinking of the land by burning the turf on top. It is said that some of these reclaimed areas are now eleven feet lower with respect to the river, than at the time they were reclaimed.



SMALL HYDRAULIC MOTORS.

THE PELTON WATER WHEEL COMPANY, SAN FRANCISCO.

For a long time the Pelton Water Wheel Company paid little or no attention to that class of small water wheels called "motors." The limit of diameter for their wheels was 24 inches, and, in an implied sense, five to ten horse power. During three years past, however, and since the sale here of a good many small wheels made in the Eastern States, the company have extended their manufacture to include such motors, combining in them the same principles and efficiency attained by the large wheels furnished by this company.

It is a wonder this was not sooner done, because the attempts to construct tangential wheels in the Eastern states was one of the worst examples in hydraulic apparatus that can be referred to. The dynamic efficiency was rarely 40 per cent., more often 30 per cent. or less, and everything went to show that the jet system was not understood by the makers of such wheels. This has left quite a "margin" for the makers here, which they seem to be availing themselves of at the present time.

The engraving above is an external view of a small motor such as is employed in light operations, operating sewing machines and dental appartus, for example. The wheel, which is the main part, is of the Pelton type, and familiar to our readers.

It is strange, beyond explanation, that so few hydraulic motors of the kind are employed. In this City, for example, there are places where a small amount of power is conveyed at a good deal of expense to factories having light machines to be operated, while on the roof, or by connection to the City supply, to operate elevators, is a cheap power, always at hand, controllable and measured.

In some American cities, New Haven, Conn., for one, there is an extensive application of small hydraulic apparatus, but it is exceptional. Here, in California, most of the foot-hill towns and cities have a high pressure supply at hand, and, as before said; the wonder is that the system has not before this extended far and wide.

VESSELS BUILT IN 1889–1890.

The following list of vessels built in 1889 and 1890, is from Lloyd's Register, and will serve to show the extensive accretion to the inland and war fleets of the United States, also the ascendancy of Great Britain in this industry, and thirdly, how fast the Germans are becoming a maritime nation.

	1889.		1890.	
	No. of Vessels.	Tonnage.	No. of Vessels.	Tonnage.
United Kingdom	656	1,180,346	716	1,197,235
United States	115	84,832	175	148,878
Germany	79	101,984	68	102,465
British Colonies	75	27,368	108	44,540
France	22	42,921	32	34,562
Norway	32	14,640	56	27,153
Netherlands	10	11,033	24	26,133
Italy	21	7,862	44	19,642
Sweden	25	7,084	33	12,692
Denmark	20	15,026	21	10,185
Greece	17	4,319	32	8,704
Russia	7	1,830	17	5,052
Austria	6	1,853	7	2,013
Other countries	5	1,531	29	7,555
	1,090	1,502,629	1,362	1,646,809

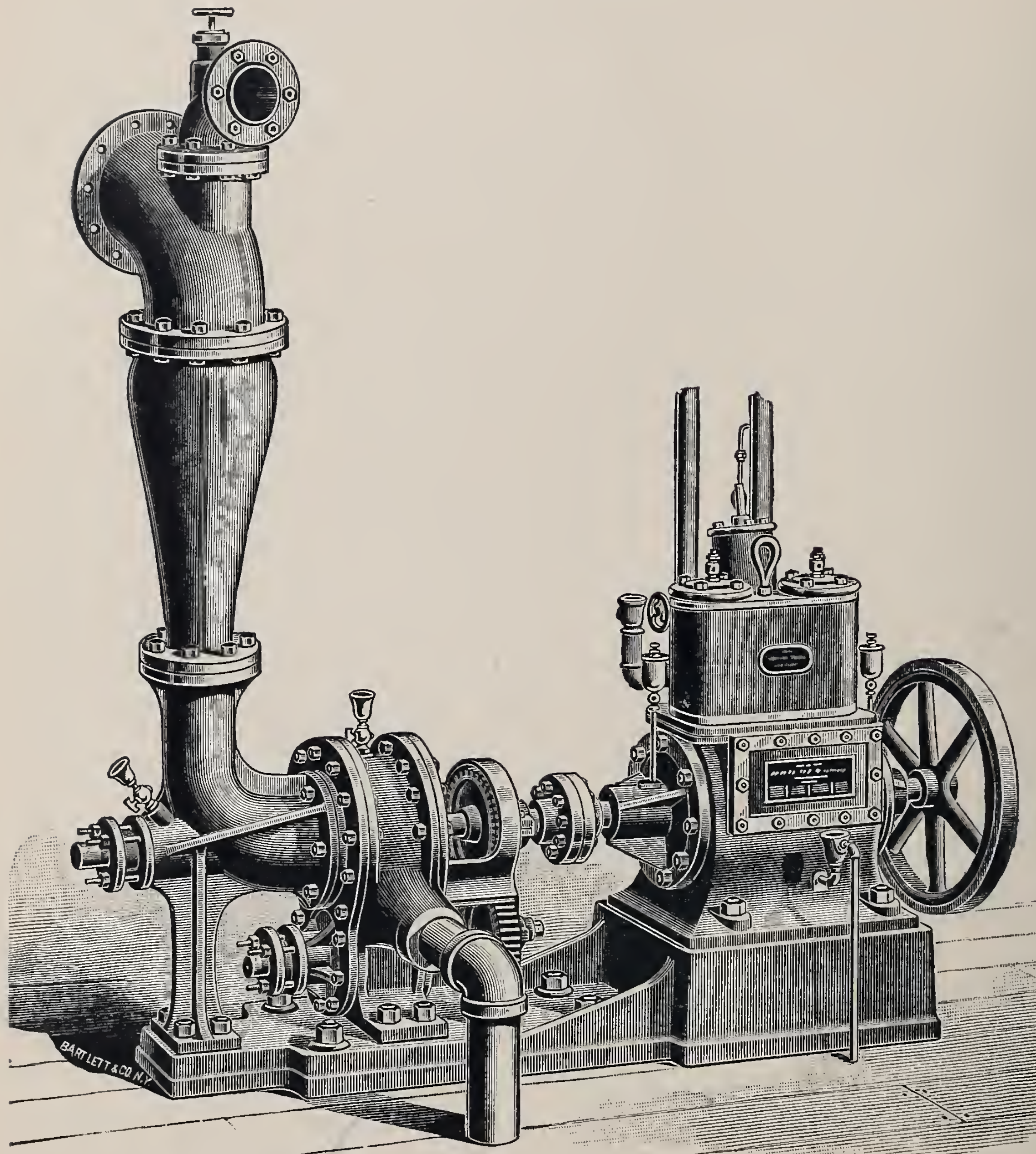
In 1888 British builders turned out 83.8 per cent. of the new tonnage; in 1889, 78.5 per cent., and in 1890, 72.7 per cent. Of the vessels built in 1889, 766, and in 1890, 880 were propelled by steam.

THE STATUS OF SKILLED WORKMEN.

Mr. A. D. Pentz, writing in the *Iron Age* on accurate work and the means for inspecting and gauging it, concludes his essay in these words: "On the other hand, no management that considers its pecuniary interests can afford to be so far elevated above those who labor for its interests as to be out of touch with them, ignorant of their efforts and interests, or to be anything but an incentive to serious work and an example for their guidance." The whole of the article is instructive and good, but this clause has a particular application on this Coast.

Some years ago a visit was made over the Cornwall Iron Works, at Birminghan, England, owned by Messrs. Tangye Bros., with Mr. George Tangye, the manager, the only one of the five brothers in active command there. On the trip around he stopped to speak to at least a dozen of the workmen, and inquired respecting their work or affairs. It seemed he knew the greater part of the 2,000 people within the walls of that immense place. He was "in touch" with these people. The same thing is true of most works in Philadelphia. We often find men working in shops there that could buy out the shop if they were so minded. Outside the works, is another matter. The difficulty we are speaking of is in carrying into a works the social distinctions of society, which is a private, personal matter, and should not be mixed up with business.

It may be said the character of workmen here is the cause of their position, but here comes the question of which is cause and which is result. Skilled labor is far from being on the plane it should be, and is, consequently, no better than we find it. The change of this is evolution, not revolution. Every shop can do something in raising the standard and give some other recognition, as well as wages, to highly skilled men. The better class of men will come when there is a place for them, and, unless they are here, we may as well settle down to the conclusion that nearly all the skilled products of organized manufacture will be imported instead of produced.



INDEPENDENT JET CONDENSER.

The drawing above has been sent without address, but is published as a good example of modern design. It represents a Dow rotary piston pump, such as was illustrated in No. 19 of INDUSTRY, February, 1890, driven directly by a Westinghouse engine. For the larger class of powers it seems a very complete machine, and if the pump will at low, or moderate velocities, maintain a vacuum, it is certainly preferable to one with valves.

It is strange that condensers of the kind, including those driven by belts, have not come more into use in this country. The Buckeye Engine Company, in Ohio, and other firms, have tried such a manufacture without meeting with much demand. The circumstances that permit, or preclude, such apparatus, are a kind of a mystery throughout the country among owners of steam power, otherwise machines of the kind would meet with more extended sale.

GOVERNMENT GUN LATHES.

Messrs. William Sellers & Co., of Philadelphia, are about completing, for the Washington Government Gun Works, a very large lathe for boring and turning ordnance. This lathe will be 133 feet long over all, and will weigh 250 tons and cost $76,000, which is about 15 cents a pound, and not a high price considering the large amount of material used that will cost more than this much in its crude form.

The face plate is geared by a wheel with 75 teeth of 4-inch pitch, 10½-inch face, and the main setting movements are all performed by power. The bed or main frame is 65 feet long, but the boring attachments make up the total length before named. Boring is one of the principal operations in making rifle cannon. Most of them are bored from the solid by first drilling a small hole, from a sixth to a quarter as large as the finished bore, and following with a "D bit" that cuts out nearly to the size of the finished bore, and ready for finishing cuts. Some of the largest guns are more than forty feet long, and when the length of the gun, a drilling implement of the same length, the head and sliding stocks of the lathe and clearances equal to the length of the gun, are added up, it is easy to see what the great length of 133 feet is for.

These immense lathes, of which a number are to be made, can also be employed for boring marine shafts, which are now commonly made with a hole through their center. Those of the *Charleston* and *San Francisco*, for example, have a hole of 5 inches diameter through their center, and as there were no appliances for drilling such long holes at the Union Iron Works, or elsewhere in this country, the shafts were procured from Krupp's Works in Germany.

A Philadelphia newspaper says that fourteen such lathes are to be made, but present tendencies in rifle gun practice point to an abandonment of the heaviest type, so that it is possible that added lathes may be of less size and weight.

ONE MAN INVENTIONS.

Prof. Coleman Sellers furnished last month an article for the *Engineering Magazine* under the title of "American Supremacy in Applied Mechanics." If the title were a little more modest, and if even the "superiority" of American mechanics were assumed there would have been room under the title for an interesting and instructive essay in methods and facts of accomplishment here, but as it is the article is but another of those stilted effusions which, to say the least, are not intended to promote either our credit or our interests.

Such writings, of which *A Centuary of Invention* is a fair example and from which the present article seems to be in a great measure drawn, are open to many objections, one of which is their inaccuracy. It is a common thing to ascribe not only the beginning but the whole of an art to an invention, and to some person, but such assumptions are wrong. Elias Howe invented a needle for machine sewing that had an eye near its point. This was a very easy thing to invent, and was inferior, as a new conception, to many other details of sewing machines invented by others, but the eye pointed needle was an "essential" feature in sewing machines which the world was then ready for, and set out to make. Howe had a patent on his needle, and so became, in public estimation, the inventor and founder of an art which might have come into use a great deal faster if Howe had never been born. The mention of Blanchard is another case. He invented lathes to turn irregular forms, of which Prof. Sellers says "nothing could be more distinctly American." The fact is that it was only at Blanchard's time when people began to perceive the want of such machines, and this method of operating had been already carried to a much more perfect state by James Watt, ten years before, and he admitted there were, in France before his invention, lathes to turn irregular forms. Watt died in 1819, and if any particular inventor deserves credit for such implements his share is certainly conspicuous. There is, however, no need of searching for inaccuracy. Most nations, of our time, have records of the early invention of nearly all kinds of mechanical appliances by their own people.

TECHNICAL SOCIETY.

The Technical Society of the Pacific Coast met on December 4th at their rooms in the Academy of Sciences building. A nominating committee was elected by the Society to present names of candidates for offices during 1892.

The time of the meeting was occupied principally in the discussion of topical questions that had been presented, and, principally, by two that related to standard dimensions for the parts of machinery. A number of members participated in this discussion, and it was evident that much interest was felt in a decimal division of linear measures. Comment was also made upon the fact that this City, almost alone in the world, has an arbitrary and irregular system of dimensions for turned, or cylindrical work.

The present metrology of this country and England will, no doubt, be crowded out in time by habit, or the force of circumstances. The government has legalized and otherwise promoted the establishment of metrical measures, such as have, almost without effort, been adopted by the principal countries of Europe, England excepted.

Our method of division for linear measures is binary for fractions of an inch, then by multiples of 12—3—2—2¾—40—8, producing feet, yards, fathoms, rods, furlongs and miles. This is confusing and irrational, so much so that for all scientific purposes, and in common engineering practice also, inches and feet are divided decimally, and a jump is made from feet to miles, so as to avoid yards, rods and furlongs. There are, certainly, no good reasons why an inch and a foot should not be decimally divided in all kinds of practice as well as in computation, even if the primary unit is retained. In all other measures except coinage it is equally bad. In weights, for example, the multiples are 24—20—16—2,000; for grains, pennyweights, ounces, pounds and tons.

The commercial loss attending on such a system of notation is considerable, not only in inconvenience but in the reputation of being inconsistent and behind in progress and improvement. The Technical Society should have a standing committee on this subject, and urge early reform on this Coast, where already some progress has been made by the introduction of the *cental* of 100 pounds instead of the absurd bushel, or cubic measure for grain, fruit, beans, potatoes, and so on.

The next regular meeting would occur on January 1st, according to the rule of the first Friday in each month, but this being a holiday the meeting will be postponed to January 7th, at which time the annual election of officers will take place, and Mr. G. W. Dickie will address the Society upon the subject of his late essay on the Commerce of this Port, and on sea carriage by cargo steamers specially designed for that purpose, and, it is trusted, will reply to some of the silly comments that have appeared in newspapers. In one case it was claimed that the scheme "was a railroad one"; in another, that ten such ships would not carry a tenth of the commerce, and in a third paper, that there was nothing for such a fleet to carry. The fact is the commerce of this port will stand a good deal of discussion. A very full meeting is expected on that occasion.

The following new members were elected:

George B. Birrell,	mechanical engineer,	San Francisco,	Cal.
Geo. E. Dow,	" "	"	"
B. F. Lacy,	" "	"	"
E. A. Rix,	" "	"	"
Hadwen Swain,	" "	"	"
D. E. Hughes,	civil engineer,	Irvington,	"
T. M. Shaw,	"	San Diego,	"
J. C. Stanton,	"	Rio Vista,	"
Alex. O. Brodie,	"	Prescott,	Arizona

Five new applications for membership were received and referred.

EDITORIAL.

LOCAL AND PERSONAL.

The make up of nearly 100 pages of matter in a new form, and in sequence as a monthly issue, has not been a light task for the publishers of INDUSTRY. The resources for composition were not much greater than the JOURNAL INDUSTRY required for its twenty pages, and to suddenly increase this two and a half times, and recast the advertising pages at the same time, has been no small undertaking, and has involved a considerable extension of the printing department. These circumstances have also prevented an arrangement of matter in the form preferred, but in a month or two the whole will come into working shape.

Present subscribers to the JOURNAL INDUSTRY will receive the magazine at the same rate until July, 1892, after which the subscription will be $2.00 a year. Five numbers sent to one order will be $8.00, and ten numbers $15.00. The publishers have a few complete copies of the forty-one numbers of the JOURNAL INDUSTRY that have been issued. These will be bound in one volume, and furnished for $4.00 each. They constitute an invaluable reference, worth many times the cost.

The essay by Mr. George W. Dickie, on the commerce of San Francisco, and means of improving the same, which is reprinted elsewhere in this number of INDUSTRY, is timely and true.

It is the custom to suppose railway management to be an incarnation of commercial sagacity, and most people think such plans perfect, so far as in the interests of the companies. This is a mistake. No such sagacity can be traced in management on this Coast at least, where the energies of the railway people have been expended upon covert, cunning schemes, that have antagonized the people, and for which a day of reckoning will come sooner or later.

Had the Central and Southern Pacific Companies devoted the money and energy expended in their contention with public interests, in creating this a port of entry and distribution, they would not now find themselves "between two fires," but the ally and participant in a permanent carrying trade that would be perpetual and expanding year by year, and in which there need be no rivals.

The circumstances are anomalous, as Mr. Dickie claims, and can scarcely be realized until set forth in his graphic manner.

The remedy is presented in "computable quantities." The shares in vessels, such as are proposed, can be taken without invoking the speculator, manipulator, or foreign bond holder, and if such a scheme cannot be carried out, no other can. Even now the opportunity has not escaped the attention of people elsewhere, and without prompt action the profits of a similar scheme will be paid into New York or London.

Mr. Dickie's essay is epigrammatic, and on the principle of Laurence Sterne's rule that "no writer of good taste will say all, but halve the matter amicably with his reader." In the present case this compliment to the reader is marked. For example, a mere hint as to the effect of the present system on manufactures in this City could well be expanded into a treatise by itself. Dear material, and the difficulties of procuration, are the main impediments. High wages is a transitory matter, one that will adjust itself to other things in good time, and when workmen learn, as they are now fast doing, that the "amount" of wages is not an "accident," but a fixed quantity. With the other two elements of industry, material and expense, it is different. Nothing but a new commercial polity can much affect these things.

Until this City has the stimulus of a free commerce, an "open port," and prices of all kinds balance with the outer world, there will be no hope of progress. This calls for commercial connections and intercourse, and the first essential is transportation lines owned and controlled in connection with the commerce and industries of the City and its environment, not under the British, Hawaiian, or other foreign flag, but under our own.

Another and principal fact that Mr. Dickie merely touches upon, is that vessels, to succeed in the proposed service, must be built for it and specially designed. This is proved by the White Star Company's freight steamers mentioned. It is claimed that these ships can carry freight across the Atlantic profitably at one dollar a ton, and are now operating at that rate.

There has been received from the Pelton Water Wheel Company, just in time for notice, the fourth edition of their catalogue relating to water wheels and connected machinery and supplies. The book is replete with useful tables of various kinds valuable for reference, besides full descriptions and scale drawings of the various tangential water wheels and motors, made by the Company here and at New York, where a branch of the business has been founded. Of all manufactures that have had their origin on this Coast, this system of water wheels is the most important, giving promise, as it now does, of spreading all over the world. It deserves a good literature, and the present is a commendable and extensive addition to what existed before.

The acceptance of the designs of Miss Alice Rideout, for the sculptured figures to adorn the Women's Building, at the Chicago Exposition, is a gratifying matter, not only to the gifted young artist, not yet twenty years old, but also to all people here who admire or understand this branch of art. Modeling is a natural gift, if there be one, still, no gift, until qualified by arduous and intelligent study, especially in cases like the present, which are something quite different from imitation. Such productions indicate an education in both the form and spirit of the subjects treated, also of human nature in its varied and occult phases, easy to explain after seeing, but difficult to originate as conceptions. INDUSTRY deals mainly with things made of iron and steel for utilitarian purposes, but goes out of its way to congratulate Miss Rideout, and to hope she will, in future, enjoy the distinction that her present work portends.

The Supreme Court of California, to whom the matter was submitted some months ago, has deecided that the legislature had the proper authority for voting a sum to be applied in presenting California exhibits, and for other purposes connected with the Chicago Exhibition. The sum voted was $300,000, which seems out of all proportion to any industrial exhibit this state is likely to make, unless, as is most likely, a good share will be absorbed in transportation. A board of commissions was selected, of which Irving M. Scott is chairman, or president, and James Phelan is a second member from this City. The other members: L. J. Rose, Los Angeles County; Thomas H. Thompson, Tulare County; Robert

McMurray, of Nevada County; A. T. Hatch, Solano County, and John Daggett of Siskiyou County.

The commission has offices at 59 Flood Building, in this City, where inquiries can be made and instructions received by those who desire to send exhibits to the Exposition. It is trusted that the character of the commission will prevent any attempt to divert this fund from its legitimate purpose, and especially to secure its disbursement with strict regard to the interests of the State as a whole.

It was the intention to say something in this number respecting the fearful earthquake in Japan, but what can be said? No one knows whence the earthquake comes or whither it goes. The occult causes lie buried in the same cloud of conjecture they did a century ago, and, if understood, what could the puny powers of man avail against these forces? One thing can be done; means of escape can, to some extent, be provided, but even these are uncertain when so little is known of the thing to be provided against. In Araga, Japan, ten thousand people were killed in the late catastrophe, and in a city and district where the low buildings were such as common opinion would set down as earthquake proof. The seismograph furnishes no suggestion of regularity in the lines of movement, and all we know is that the liability of a building to fall is as the cohesion of its mass, in proportion to weight. If the "veneered" iron buildings, now being constructed here, do not withstand earthquakes, there seems nothing to fall back upon.

NOTES AND COMMENTS.

The "home market" philosophy of which we hear so much, may have, in some cases, a meaning and reason in it, but, if carried out, it would destroy the division of labor, commerce and national intercourse. No state or nation could sell any more, and would likely sell much less, if everyone bought in a home market and nothing was exported. It is a sophistry, growing out of an imperfect understanding of the causes that promote industry and commerce. We have noticed that no one is so much pleased with export sales as "home traders," yet such sales are a direct violation of their philosophy.

The record of the Navy and War Departments will be much needed by the present administration whenever it comes to a reckoning with the country at the end of the term. Secretaries Tracy and Proctor have not advised the country as to the amount of piety they have infused into their respective bureaus, but the honesty, which is an analogous quality, is quite apparent. The re-appointment of Chief Engineer George W. Melville, with rank of commodore, the abolition of post traders, and the application of civil service and promotion rules, are hopeful signs of improvement, not conspicuous in some other departments.

The Government has provided for adding 100 torpedo boats to the American Navy, and there is a chance that about the time they are completed none of them will be wanted. This torpedo business has always seemed a sneaking kind of warfare, and no one will regret its abandonment. All kinds of war is barbarism, if we go to the bottom of it, even when calling prowess and emulation into force, but when it descends to "sneaking" methods, war is intolerable. Of course, no nation can take a moral view of such matters. Nevertheless, it would be greatly to our credit if torpedo warfare should never find place here, and this country be the first to denounce it.

Mr. J. H. Tingman, Secretary of the Mining Stock Association, that is trying to recover some part of the money or bullion appropriated by the "mill ring," in Virginia City, says the contracts for milling ore are made "payable in gold coin," and points out the inconsistency of this on the part of the mill company and its owners, who are "silver men," whatever that means. Mr. Tingman's efforts are wasted, except in so far as some moral weight may be added to the testimony now being offered in the law trials. A charge of inconsistency against the Nevada Senators will not much effect their reputation, and moreover, will not much effect public opinion, which no longer exists in any degree worth mentioning. Anyone who will consider the complaisance with which the public view the operations of these rings, and robberies of all kinds at this day, will see in that fact the principal one. The common sentiment is: "Of course, the Comstock milling companies appropriated bullion belonging to the mines." Whoever supposed otherwise? As to consistency, who expects that?

There has been going the rounds of the press an account of how Thomas A. Edison denounced patents, and claimed they had never been of any value to him. Granting that Mr. Edison said so, and that is barely possible, it must be set down among some other unguarded statements that he has made. The various companies, and the means that have enabled Mr. Edison to prosecute his experiments, could not have been commanded without patents, and that far, at least, he has been a beneficiary of the system. On the whole it would have caused less surprise if Mr. Edison had been reported as saying, that without patents on his inventions, he would have made no progress at all.

Almost everyone who has done any reasoning in the matter will not be surprised at the announcement that the opium business carried on from Puget Sound is an organized affair—a systematic swindling of the Government, or rather an infraction of its laws. The small amount of duty collected from opium may go a little way in defraying the prosecution of the rogues, which is now threatened, but that there will be any actual revenue, no one expects. Why not abolish the duty on opium? That would at once break up smuggling. We are informed that it is sold at the price of the duty here. The idea of putting a duty on an article that can be so easily hidden is at best a mistake and a mere temptation to venality.

The *Engineer*, London, seriously criticises the papers recently presented and read before the Institution of Mechanical Engineers in England, using the following remarks: "Men must not be treated as boys who may as well be asked to hear a paper and discuss a subject because it will be something that will amuse them and hurt no one. For the credit of the Mechanical Engineers, its papers should attract the attention of men who are engaged in the serious conduct of professional work, in engineering, manufactures and trade; men upon whom the country depends for active progress in the various branches of mechanical engineering." These remarks related to two papers. One on the modern construction of Lancashire boilers, and the second was a report on alloys of metals, neither of which the *Engineer* claims contained any new matter. It is just as well to have plain talk over these matters, but the only harm that can result is the effect of deterring members from presenting their papers for fear they may come in the class of "known before." The *Engineer* is, however, too severe, especially as its criticism relates to the paper on Lancashire boilers, because the Institution of Mechanical Engineers is not a local body in respect to its papers, and while Lancashire boiler construction may be a familiar matter in England, it is not so everywhere else, and not so common as it should be everywhere.

Evidences increase of an intended sale of the Trenton, and other iron works, of Cooper, Hewitt & Co., of Trenton, N. J., to a foreign syndicate. If Peter Cooper were living, it is probable no such sale of these works would be made. He died claiming, as his friends are willing to admit, that he "never knowingly had a dishonest dollar in his safe," and to sell these works, either to foreign owners, or to home owners, who have been diligently working to enhance the value of the product by adventitious means, would, by Mr. Cooper's standard, be putting questionable dollars in his safe. We can well understand that Mr. Hewitt has but little confidence in the continued, or at least regular prosperity of our iron industry founded on dear material and high prices. He has said so more than once, and his offer to sell these vast works, worth about $5,000,000, is not an assuring incident in the iron industry of this country.

The English people, contrary to their asserted national policy, which is to let trade, commerce and manufactures alone, as much as possible, have been trying to regulate their railways by special laws, and with the usual result in such cases. Every law to enforce some rule, needs two or three more laws to explain the first one, prevent evasion and provide for unlooked for contingencies. The railways in England are far from occupying the powerful position they do in this country, and there is not the problem of non-execution of the law, in so far as it can be defined and understood; but it is the principle that is wrong, and the chances are, that the railway laws, like the navigation laws of fifty years ago, will be repealed. Our own experience in the case of navigation and railway laws is much the same. Our foreign carrying trade has been destroyed, and railway abuses have been on the whole augmented, or will be in the end no doubt, by the Inter-State Commerce Act. Certain abuses may be remedied, but the relation of railways to communities is a different matter, and varies too much for general rules.

The Traffic Association in their deliberations should not forget that old rule on which the law of the common carrier rest, namely: That he deals with four things — bulk, weight, risk and time. Further than this a carrier has nothing to do with goods put into his charge, and any assumption beyond is impudence. As to value, that is comprehended in risk, and no one can think of or invent any contingency, except for dishonest ends, that the four conditions above named do not include. To elaborate them further. Bulk gives the space occupied, and with weight is a limit of quantity. Risk qualifies the amount to be made good in case of loss or damage to goods, Time, or the rate at which things are carried, qualifies expense, and also facilities. At this day carriers are exercising a function that has hitherto been cautiously employed by governments only; that of opening packages to learn their contents.

One of the daily papers in a late issue has a remark respecting the Bell telephone combination that contains a hint of wide dimensions. In susbstance, it is said some recent improvements by others will compel the present telephone companies to bring to light some of the numerous inventions which they are "keeping in reserve to meet open competition."

People are apt to think of monopoly as being an incentive to develop improvements, and it is, no doubt, in the early stages of some of the arts, but it may also be, and oftener is, a direct bar to improvement. Why should the Bell Telephone Company, or any other with a monopoly of a line of business, improve instruments, service, or anything else, so long as they can collect "all the traffic will bear?" Improvement would only benefit the "consumer." The Wheeler & Wilson Sewing Machine Company, so long as their patent on the rotary shuttle lasted, never thought of improving their machines. People who wanted a machine of that kind had to put up with a crude, inconvenient design, with the cloth feed acting the wrong way, but just as soon as the patents expired, there was a new Wheeler & Wilson machine having all kinds of improvements. So with the Bell Telephone, and all of its accompaniments, including a service charged at two prices; it will be improved, and very rapidly too, when the monopoly expires. Competition is not only the "life of trade," but is the life of about all beside that one is called upon to deal with in this world.

The rumored deposition of Henry Villard from the presidency of the Edison General Electric Company, is not inconsistent with published statements of his, respecting electrical matters. These statements point unmistakably to a belief on Mr. Villard's part that electricity is a primary power, capable of supplanting steam, also to other vagaries that are inconsistent in the chief officer of an engineering and manufacturing company. Why a "financial man" should be selected for such a position is another query that will suggest itself. Certainly there was not required any of the usual "floating" expedients to capitalize the Edison Company, and this alone can seem a reason for Mr. Villard's selection as president. Speaking of presidents, our method of organizing share companies seems less perfect than the English one, where a board of directors exercise executive control. One of these is elected "chairman," and another the "managing director," to take charge when the board adjourns, and conduct the business until the next meeting. The secretary, which, with us, is a prominent position, is there only a clerk of records, with no official function.

Now that the mail subsidy scheme for marine service has settled down and is ready to be cast up, it does not seem a very promising affair. The Postmaster-General's scheme included "sixty-two routes," out of which only eleven were bid for, or rather applied for, because there was no bidding at all, if by that is meant competing offers for the service.

Of these eleven routes, four called for the establishment of new lines, but some "irregularities" in the proposals caused two of these to be rejected, namely: A service between Boston and Liverpool, and one between New Orleans and Colon. This latter proposal, if it had been accepted, would have put one half of all the subsidies into the hands of the Pacific Mail Company. In three other cases, lines receiving the subsidies are established, and their contracts call for no augmentation of ships or speed.

Last month it was pointed out in INDUSTRY how these proposals were the result of collusion, and that no two bids were received for the same service, and now that the result can, as at first said, be summed up. The end will be the payment of a lot of public money that will retard, rather than build up our shipping industry. It has also been pointed out a good many times before the passage of this Act, that competition was no part of the scheme of these marine bounty hunters. They wanted no competition, but a clean specific vote of money to certain firms and companies. This is the result, in effect. Four contracts out of nine to the Pacific Mail Company, that pays $10,000 monthly to a British line to not land at Colon, so that a tax of $40 a ton can be exacted from American merchants shipping to Valparaiso, or other ports on the west coast not more distant. The authority for this statement will be found in the United States Consular Reports of last year.

What is required, is a repeal of the Navigation Laws, with all their exactions and absurdities, and the American ship owner placed on the same basis as those who compete with him. His ships should be taxed when in commission only; the dues of all kinds lowered or abolished; in short, he should have some of the privileges and immunities accorded to railway companies.

ENGINEERING AND INDUSTRIAL.

There has been received a modest and convincing circular from the Greiner Cupola Co., of Chicago, describing a cupola of that name, now extensively used in Europe. The especial feature of the invention is the induction of air at various heights around the charge by means of helically disposed tuyeres, in addition to the usual windbox and common tuyeres. There seems to us something very plausible in the claims for increased efficiency and fuel saving by this method, that foundrymen may do well to investigate.

Modern marine engines, which have assumed a typical form and proportions in most respects, still present a wonderful divergence in respect to height or the length of the connections, and the angle made by the links or connecting rods. Lowering the center of gravity causes a saving of material and room, but must be balanced against certain undesirable operating conditions. Still the subject as an abstract one, has not been, so far as we know, discussed. The lowering of the machinery, as much as possible below the water line in war steamers, has reached the limit one way, and favorable conditions for working have led to an extreme in the other direction, but how high, or how low, a vertical marine engine may be constructed with an assumed stroke, does not seem to be a subject of discussion.

In one of our foreign exchanges is illustrated an example of sluice gates for the Manchester, England, Water Works, a double stem is employed, attached by eyes at the sides of the slide, and then passing up to a stiff crosshead above, in which the operating screw has its bearing. There are some advantages in this because the stiffest single stem will permit a gate to "slew" in its guides to some extent.

There is some property in the leek family of plants that causes glue to adhere to iron. People often scout this idea but it comes up again and again. Some chemist should "rise and explain." Perin, the celebrated maker of band-sawing machines, employed onions or garlic, we do not mind which, to cause the glued-on leather coverings to adhere to his iron band-saw wheels. The recipe comes up regularly, alternating between garlic, onions, and the progenitor of all, the leek; or what we call leek.

It is singular to notice how persistently English makers cling to friction clutches of small diameter. Their idea of such a clutch seems to be a collar, nipping a shaft, or, in other words, to move the clutched surfaces at as slow a speed as possible. Now, the driving power of a clutch, when we assume a coefficient for friction, is directly as the speed of the bearing surfaces, and, consequently, directly as the diameter, or distance from the center. Some rules for such clutches can be set down as follows: Balanced parts, balanced strains; avoidance of centrifugal force; gripping surfaces as far as possible from the center, and, finally, substitute the whole clutch with a shifting leather band whenever possible.

A correspondent of the *American Machinist* undertakes to describe the qualities and duties of foremen in machine shops; that is, what foremen should do and be. A good many people have ideas on that point, and think a foreman should know everything, be able to do everything, and if there is anything left, should learn that as soon as possible. Most foremen want to do what is required, but nature has not bestowed on one man the power to execute the duties. Foremen are born. The best of them can, only in a limited way, discharge the duties that such a charge is supposed to comprehend. If any one doubts that, let him try to find an ideal foreman.

A correspondent of the *American Machinist* says the common rule of providing increased grate area for wood fuel is wrong, and, not only wrong, but the reverse of what is required. He claims that in burning light fuel, less grate area is required than for coal, and that furnaces should be deeper. In erecting wood-burning furnaces, there should always be 22 inches or more of depth from the boiler to the grates. For cordwood, shavings, sawdust, and so on, a depth of 24 inches, or more, is best, if the fire is controlled by a damper, as it should be, and the furnace kept full of fuel.

Jones & Britton, of Liverpool, England, have been scheming out a new counter-sinking machine for ship's plates, that contains good suggestions, if it is not the end in that line. The spindle and its gearing runs on a trolley mounted on a long swinging jib, and is run out and in by the same lever which advances the drill spindle, so a workman takes hold of this handle, and, without other adjustment "pulls the spindle over the holes" and does the work, the movements all being free enough for that purpose. It is not a symmetrical implement, but is the best one for that purpose that has appeared.

In the discussion of topical questions at the late meeting of the Mechanical Engineers, at New York, friction clutches received some attention, and it is evident that our Eastern friends have not arrived in that branch of constructive art to what is attained here in California. The principal objection, and a sufficient one, to clutches of the kind, was the friction of the running bearing and its lubrication, when the clutches were out of use. Many, if not most of the clutches in use on electric light plants on this Coast, have no running bearings at all, except the collars for shifting. In the older forms the pulleys have double rims, one sliding under the belt to start and drive, the other stationary for the belt to rest upon when the clutch is disengaged. A later and better modification is to provide axial support for the clutch pulley, outside and independent of the shaft, so that when stopped there are no running joints. Either modification obviates the objections urged, and it is a matter of astonishment that they are unknown to the members participating in the discussion above referred to. One of these California clutches is illustrated elsewhere in this number.

A Mr. Joseph Rehm has invented an expansion water trap that has an element of novelty. The pipe is disposed in a circle or what is equivalent to one, and there are tie rods across the sides in two directions, so that expansion or contraction takes place around the perimeter. It is, in effect, an expansion trap in small space with a very long tube, and that far is an improvement. Can anyone tell why expansion traps are not more used, and why they are not, as all inferences should teach, good serviceable instruments? We could never see why an expansion trap should not perform well.

Jet propulsion for vessels has, as we think, culminated in a plan proposed by Mr. Meister, of Liverpool, England, in which a large volume or body of water is pushed out through tubes set as nearly as possible parallel to the keel. Direct-acting steam pistons being employed to thrust the water out. This, in so far as efficiency, is all right, but there are mechanical impediments in such a method. It is not a very fast vessel at this day that moves 1,500 feet in a minute, and the idea of reciprocating water pistons moving at such a rate, or the quarter of it, is preposterous, and useless too, when the floats of a feathering wheel are the same thing in effect as the pistons. The best way to deal with jet propulsion in the future is to consider it a mental disease. "Duckfoot" propellors are science in comparison.

A friend came into this office a few days ago to ask where he could have some work ground, and it took some time to think where, if at all, he could find machinery to grind a few feet in length. This is a fault in shops on the Pacific Coast. It costs but little to arrange for grinding shafts, piston rods, and so on, and it is one of the essentials in modern practice. Anyone who doubts this, and will put a draw filed piston rod in a grinding machine, will be convinced of how far turning and filing fails to meet the requirements, especially for metallic packing. The first pass of a wheel over a file finished rod, will cause it to look like the spots on a leopard. More than once we have seen the consternation of railway mechanics when a piston rod was put in a grinding machine and its faults exposed. One example of grinding is enough to destroy confidence in work finished in any other manner. Every true journal should be ground, and all hardened work "must" be ground, so that a shop without lathe grinding apparatus is wanting in essential implements.

The Continental Iron Works, of Brooklyn, New York, have made a good investment in their plant for corrugated furnace flues. This is a very sensible kind of improvement that will make its way all the more in the end by reason of quiet, confident presentation. There is a gain of both strength, endurance and efficiency, with a moderate increase of first cost. We have too few internally fired boilers, especially on this Coast, where fuel is dear and feed water is not bad. The Metropolitan Elevated Railway, at New York, have ordered for their power plant internally fired boilers with corrugated furnaces.

Four large fly-wheels have given away during a period of four weeks, which, to say the least, is a coincidence. One at Chattanooga, Tenn.; one at Cincinnati, Ohio; one at Greenville, Pa.; winding up with another at Manchester, N. H., where three persons were killed. It is not necessary to go into descriptions of the wheels, or the circumstances of their failure, further than to say that in each case the rules respecting cast iron fly-wheels were violated, although it is not clear, or even probable, that fracture arose from over-strain on the rims. A good rule is to divide 1,500 by the diameter in feet for the number of revolutions such wheels can safely run, provided the "fastenings" are equal to the tensile value of the rims, and the rims have a symmetrical section. There is also the problem of quality in the metal, but the fact is, the limit is a commercial one, and makers drive wheels as fast as they dare, to save weight and cost of iron.

Three of our great machine tool-making firms have been constructing large bending rollers for plates. The first machine was made by the Niles Tool Works, for Mare Island Navy Yard, and since then Messrs. Bement, Miles & Co., and William Sellers & Co., both of Philadelphia, have made similar or larger machines. What the relative merits of design may be are not easy to discern, unless one is familiar with some particular work to which the machines are to be applied, but it is safe to claim that in all these cases the plans are commendable and good. The machine made by Messrs. Bement, Miles & Co., for the Newport News Co., weighs in all 150 tons, and receives plates 1¼ inches thick by 15 feet wide, or long, all motions being by means of attached steam engines forming an integral part of the machine. The machine made by Messrs. William Sellers & Co., was for the Boston Navy Yard, and judging from the diameter of the rollers is the heaviest of the three.

Mr. Maxim concludes, or proves indeed, that the most powerful motor in proportion to weight is a steam engine. He claims to have constructed engines of 300 pounds weight that developed 100 horse power, meaning, as we suppose, the engines alone, and not including boilers. His steam generator had 48,000 brazed joints, and was heated by 45,000 gas jets, generated from hydro carbons. In his proposed aerial machine the dead weight of motive power, fuel, water, and three men, is 5,000 pounds, and the margin over suspension, or sustension, is nearly one half, all of which may be curious and true, but not useful. No one wants to go "that way" was the utilitarian view of a friend, to whom these quantities were given.

A writer in a St. Louis paper says he knows tool works where twenty to thirty boxes of files are used each season. This is, no doubt, true, but if we were purchasing tools, some other shop would receive our patronage. The amount of files consumed at this day is apt to be inversely as the amount of skill in a shop. The day of files is past, and the only circumstances under which they are required is in special work, when there is not "duplication" enough to permit the use of other means to remove surplus metal. Filing is an expensive process, not only in the time consumed and waste of labor but in the wear of implements. There is the further objection that filed surfaces are never true. There are other and better ways of shaping and cutting metal, also of smoothing it. "Chordal's" nigger, boring out a steam cylinder with some sand, and an old grate bar, is an aggravated example of the filing process.

ELECTRICAL NOTES.

The *Engineer*, London, in computing the cost of electrical heating, puts a discouraging face on the matter by claiming that heat thus obtained, at the present price of electric energy, will cost eight times as much as the same heat derived from gas, at $1.00 for 1,000 feet of gas, and by parity of reasoning, sixteen times as much as if derived directly from coal. The functions of electricity are quite enough now, more than we can understand and deal with for a long time to come, even if new ones are not added, and the reconversion of electricity to heat again after it has gone through a steam engine, dynamo, and a heating apparatus, is not a very hopeful field for experiment.

Mr. Gisbert Kapp, in his late cantos lecture on electric transmission, closed with some remarks on the segregated driving of machine tools in that manner, citing a large number of examples in England. This is a case wherein this country should take the lead, or at least begin furnishing machine tools with motors attached. The amount of power required is small, not more than ¼ horse power for small tools, and not often exceeding 1 horse power for larger ones of the cutting kind. The convenience of independent power in stopping, starting and reversing, is such that economy of power becomes a secondary matter.

Patent 460,122, recently granted to Mr. Edison, filed in 1882, and ten years in the office, relates to generating electricity by heat, or directly. The claims read thus:

"(1) The process of generating electricity, consisting in subjecting a body of carbon or carbonaceous material to a high temperature in the presence of an active agent composed of a body of oxides capable of combining with carbon at a high temperature, and a positive element composed of a metal not acted upon by such active agent, but located in contact therewith, substantially as set forth. (2) The combination, with a melting pot and furnace, of a compound, one element of which attacks carbon at high temperatures, and a generating or soluble electrode composed of compressed and consolidated carbon or carbonaceous material, substantially as set forth."

For a patent of this kind to be ten years in the office is not encouraging, but it was, no doubt, the fault of Mr. Edison himself, or his counsel.

An electric railway company organized in Chicago, with a capital of $2,500,000, purposes to construct electric railways with underground conduits that are insulated and sealed, except contact points thirty-two feet apart. These points are reached by a bar of metal, also thirty-two feet long, that spans two of the fixed contact points on the conductor, or is always in contact with one of them. There seems to be in this proposition a distinct principle or mode of operating, corresponding to the "pick up" system of pneumatic railway cars, and there is no doubt of very effectually preventing leaks, if there is no exposure except at carefully insulated points thirty-two feet apart. The main wires, after insulation, are to be enclosed in a lead pipe, and around this is a subway of steel and iron. The company, it is said, have applied for permission to erect a line in connection with the coming exhibition.

MINING NOTES.

If one is to believe the weekly reports of mines that comes around, principally taken from newspapers published in the vicinity of the mines, the industry is all the time in a wonderful way of prosperity. There are rich strikes on all hands, innumerable stamps about to be started up, and a general prosperity of everything announced. This is pleasing, perhaps is harmless, but is not accurate, consequently, not valuable. There is no way commercially practicable, of securing periodical reports of the condition of mines and mining property. Nearly all mines are incorporated, and the shares in the market. The incentive to make a good showing is strong, but there is the question as to whether general confidence is not destroyed to such an extent by these favorable reports that they really hinder the sale of shares, or of mines. It being now holiday times, and the happy season of the year, we had better "believe the whole lot," and insist that all the mines are at work and prosperous. It is certainly as near true at this time as it has been for a long time on this Coast.

The practically closing of the great New Almaden quick silver mines in Santa Clara County, is an event of great importance in that district, and to the State at large, and is accompanied by circumstances seldom, if ever, seen in this country, the dismemberment of a community, developed and grown up, segregated almost completely from its immediate environment and completely from the world outside. There have been many stories of the improper control of these people, numbering about 1,500, and, perhaps, has been in respect to politics, as there is everywhere that such influences are possible, but it seems the company have taken every means of ameliorating the condition of their discharged people by furnishing them supplies, money, and procuring them situations. It does one good to see, now and then, some evidences of "soul" in a corporation, and we imagine that the kindness was inspired by Mr. Randol, the manager, who has so long led and directed the mine force at New Almaden. The ore has sank in quality and increased in cost of raising, until the balances went the wrong way. The New Almaden mines are, for California, a veritable industry. The first ore was reduced there in 1845. Extensive operations were commenced about 1850. From 1858 to 1860 the mines were closed by litigation. In 1870 the property came under the management of Mr. J. B. Randol, who has ever since directed its affairs in a successful manner. The profits of the mines from 1871 to 1890 were $5,230,528. The whole product during this period was worth $14,597,875. The total number of flasks, is 925,459, of which only 8000 were added in 1891. Each flask contains 76.5 lbs. The company will, no doubt, secure and develop other cinnabar mines in California, if such there be.

Messrs. Alexis and Louis Janin of this City, introduced some time ago at the Mexican mines, some improvement in the processes of reduction that have, it is claimed, proved very successful, and they now propose to try the same improvement, at their own expense, on Comstock ores at Virginia City. The processes have not been made public, but coming from the source they do, should command attention. New processes for reduction of ore are not rare. They come around with surprising regularity; saving all the gold—sometimes more than the ore contains—at a trifling cost, but these processes generally emanate from some one who knows as mnch of mining as Congressman Farwell does of war vessels, and disappear as rapidly as they come.

Congressman Bowers, of the Pomona district, it is said, has printed at his own expense, 1,000 pamphlets describing the Temescal tin mines, and has also paid for 500 small tin bricks to distribute among the unbelieving.

Our exchanges come with denunciation of those who want to "stifle the tin industry," and one who does not do a little reasoning in the matter will be apt to suppose that there is in this country a strong opposition to the tin industry. Such an assumption is in no way warranted, so far as can be seen. This railing is to direct attention from the real issue, which is a tax of 2.3 cents a pound in the interest of foreign owners.

What Mr. Bowers wants to prove with his pamphlets and tin bricks, we do not understand. It is notoriously known that the Temescal mines were sold in London in 1890, and that even the machinery, of which $70,000 worth has just been received, has been imported from abroad. It will be a pleasure to receive one of the pamphlets above named, to see where the patriotic argument comes in.

Colonel Robinson, in the sale of the Temescal mines, prepared a prospectus setting forth in definite quantities the nature of the mines and their product, which appealed to the commercial understanding of sensible people. This can be understood, and the result was a sale of the property, but a tin brick is not a convincing argument, and, besides, there is nothing for sale.

There is no reason why plates of iron and steel should not be tinned in this country with native or other tin, but this is not the point at all. It is the plates themselves that are the object of the 2.3 cents a pound, and Temescal pamphlets and tin bricks have no direct bearing on rolling sheet steel and iron, or on the enormous importations that were made for personal profit by these tin makers previous to the present tax going into effect.

The disturbance of prices in the tin trade have been the occasion of great losses to the country, as no one can pretend to deny, and just how these losses are to be recouped is a problem Congressman Bowers should set himself about instead of distributing pamphlets and small tin bricks.

MISCELLANEOUS NOTES.

To people on the Pacific Coast, the coal census of the United States presents a problem. In 1889, 141,000,000 tons of coal were raised, and the average cost when mined; that is, raised on the dump, as we would say, was 99 cents a ton. The same year the cost of mining coal in England was six shillings sixpence a ton, but as the coal was all bituminous, and the American coal, to a great extent, anthracite, which is more expensive to mine, we may safely set down the cost of coal mining in this country at one half as much as in England. In Germany, and in France, the cost of mining is much more than in England, and even in Belgium the cost is double as much as in this country. In Pennsylvania, the output of bituminous coal per man was over 600 tons. In Ohio it was over 500 tons, and in Virginia over 600 tons. How is it then that the price of coal is so high here, or anywhere else in the country for that matter, and why must a duty be paid "to protect labor" when the men are doing double work for 20 per cent. more wages? Coal hewers, that is men who "get" the coal, as it is called in England, and who constitute more than one half the whole force, receive in Northern England $6.00 per week, to $7.93 paid in Pennsylvania, which, all things considered, is the lowest rate.

The French subsidizing scheme to build up their merchant marine, has not operated very well. In a recent investigation of the matter by their own government, it seems that they have now less ships, and but little more tonnage, than when the subsidy scheme was put in force six or seven years ago. One fact was not discussed, a disagreeable one, perhaps, and that is that most of the subsidies paid have found their way into the pockets of British owners. The French operate ships cheaper than England can, or ought to, but they tax, inspect, regulate and harrass them out of existence.

Engineering, London, had recently an article of interest on the wages problem, showing a great advance in the "rate" of wages in some Continental countries, notably in Germany, but, as usual in such cases, said nothing of the "amount" of wages, or what the increment of rate had produced. It is strange that one side, and the most important side of the wages problem is continually omitted in such essays. If followed to the production of wages it will be found, in most cases, perhaps in all, that the accretion of rate is due to, or permitted by either increased production or a fall in the price of material. The wages problem, or as they call it in England, the "industrial" problem, is just now commanding more attention than ever before.

Professor De Volson Wood has been experimenting with a pulsometer, or steam vacuum pump, having 4-inch water pipes, lifting 25 feet, and found a theoretical efficiency of .013, which is, however, less understandable than the dynamic duty, which was from twelve to thirteen million foot pounds for 100 pounds of coal, This is one eighth the duty of a good pumping engine of the water works type, and is rather discouraging. The fact is that economy in steam working is found in connection with high and maintained temperatures. There are, however, many cases where a pulsometer is an economical machine for temporary use and in emergencies. All these things can be, and are shown in computations that are as reliable as the course of physical laws, but very few can understand or believe such computations, and will continue to think that steam can be employed in contact with cold and flowing water without much loss, whatever the professors may say to the contrary.

It is said that a common watch will indicate the cardinal points in a very simple manner. If the watch is held, at any time in the day, so the hour hand points to the sun, then the south will lie on a line half way from the position of the hour hand and the figure 12 on the dial. For example, if at 2 o'clock the hour hand is pointed to the sun, then the figure 1, half way between, will be pointing to the south. If the same thing is done at 4:30 then the south line will be at 2:15 on the dial, and so on.

The Treasury Department of the government, in its construction of the tariff laws, or else the tariff laws themselves, seem to deal but little with common sense in various rulings. The *Century*, for November, in speaking of the remarkable productions of Mr. Cole, called wood engravings, says: "To the Treasury Department Mr. Cole's blocks are merely 'manufactures of wood,' and as such, are heavily taxed at the Custom House, while the merest daub of the youngest tyro of an art student may come in free of duty." This is fine encouragement of wood engraving, a department of art in which Americans excel, and which has recently had such favorable recognition at the Berlin exhibition. We are unable to understand Mr. Cole's work as "wood engraving," but whatever it may be, a premium would be much better than a tax for its encouragement.

Mr. J. W. Clarke, road-master of the Chicago and Western Indiana Railway, finds that the expense of maintaining 1,000 feet of track, laid on metal ties, has been $45.50 for nineteen months, and that the main part of this was in "ballasting" the road up to the level of a parallel track laid on wood. Mr. Clarke further says the track has been exposed to heavy traffic, is smooth and pleasant to ride over, and that the rigid fastening of the rails, and their maintenance in a true vertical position, has avoided much of the wear common on wooden ties. The circumstances of railway construction in this country are such, that except on a few of the main lines, first cost is the main thing considered. There has been laid down, in various places, sections with metal ties, and it is time now that some account of the results should appear. The railway lines of the Netherlands have, for their length, done most in the way of laying metal ties, and, so far as known, the result is a saving in every way over wooden ones in that country.

In *Stone*, for December, we are informed that "aluminium cannot be made from clay." A startling statement to most people who have, from various sources, learned that common clay is "half aluminium." The above authority, which is a good one, further says:

"Up to the present time there has been discovered no known process whereby aluminium can be economically extracted from clay, and this for the reason that the metal there occurs in the extremely refractory condition of silicate. The only ores of aluminum that can be utilized under the present methods, are the double fluoride of aluminum and sodium known as cryolite, the entire supply of which is brought from Greenland, and the oxides corundum and beauxite. The first named of the two is of value for abrading purposes, and its production in the United States is confined mainly to North Carolina and Georgia. This causes it to be rather an expensive ore."

The *Wetmore* whaleback ship, that crossed the Atlantic and then sailed from Liverpool for Portland, Or., via the Straits, has come to grief, and been towed in with a claim of $250,000 salvage against her. There is no doubt that Captain McDougal has improved in various ways that type of vessels known as barges, in so far as reducing the cost per ton of carrying freight, but to assume that the experience of a hundred years in naval architecture is to be "upset" by the inventions of one man, or firm, and in a few months' time, can result only as a "fad." The history of the past furnishes no precedent for such wonderful discoveries, and any change in the order or principles of naval architecture will come as a work of evolution. The writer, some years ago, attempted to trace, in Scandinavia, the causes that had led to the present type of coast and fishing boats there, and at the end concluded that they were the "evolution" of at least one thousand years. So far as could be ascertained from sketches, drawings and descriptions, there had never been in one generation any change marked enough to be chronicled or defined. The boats are as near perfect for their uses as human ingenuity can hope to make them.

In several of our exchanges is noted, as an evidence of skill, the making of a minute steam engine that will stand in a space of less than half an inch square, containing 148 parts, and the whole to weigh only three grains. The latter is, no doubt, a mistake, but no matter, we are not repeating the fact or the description further than as text for saying that the term "skill" applied to such work, is employed in a strained sense.

People must have amusement, and facts show that a portion of human amusement must consist of freaks. The marvelous trait must have its share, and minute mechanism is a proper subject, so the makers of these small engines are pursuing a legitimate business in producing them, if done for sale, or for their own amusement even, but the faculties brought into play are not skill in the usual sense. Patience is a main thing, next a delicate touch and good sight, but, most of all is a resignation to wasted time. It is rather hard to say how many mechanics, in the exact branches, could not make such an engine, "if they wanted to." Skill, as it is commonly applied, means proficiency in some art of a general and useful nature.

The Washington and Georgetown Cable Railway, at Washington, D. C., is, in effect, a central road through that city. It will be, when complete, the most notable work of the kind in this country. Washington is now the finest city in the United States, and a cable line traversing its center, beginning at the Capitol, and passing all the principal departments of the government, should be worthy of its environment. A steep portion of the line at the Treasury building, has, no doubt, determined the form of traction, and it is well chosen. Sections of the cable conduit, which are published in the *Street Railway Journal* for December, show a construction that has only excellence for an object. The plans were designed by W. B. Upton, of Kansas City, the chief engineer, in conjunction with Mr. D. Bontecou, consulting engineer to the railway company, and the work is being erected under the superintendence of Mr. David Carll, the resident engineer. The engines will be made by Messrs. E. P. Allis & Co., of Milwaukee, Wisconsin. There will be 15 miles of line, and the speed of the cables is set at nine miles an hour.

It is to be regretted that with all of our knowledge respecting petroleum, its procuration and manufacture, that the new field in Peru has not come under the control of American capital. The amount this far received is not great, but enough to indicate a permanent source. Lima is now supplied, and arrangements are being made to send petroleum to China, Japan and Hawaii.

LITERATURE.

Engineering Magazine, December, 1891.

The first article in the *Engineering Magazine* for December is one by Prof. Coleman Sellers, under the title of "American Supremacy in Applied Mechanics." A little more modesty in title, and some more practical information respecting processes and inventions in which we may claim "eminence" in this country, would have made an interesting essay; as it is, we fear there is another corner supplied on which to hang ridicule and adverse criticism. It is on the whole very like, and was no doubt inspired by *a Century of Invention*, which, to say the least, extended neither our reputation nor interests in the way intended. To set down Howe, who invented one feature that afterward became essential in sewing machine manufacture, as the author of the whole art, or to ascribe to Thomas Blanchard the pantograph system of producing irregular forms, after the same thing had been invented by others, notably by James Watt, is "provincial," and we will add that all this class of writing, and in all countries, for all countries have it, is characterized by unavoidable inaccuracy.

In some cases, as that of John G. Bodmer, when a learned society of unquestioned standing like the Institution of Civil Engineers, undertakes to put on record from careful and proved sources, some account of his works, and during the time of these works, such matters can lay some claim to accuracy, especially when, as in Bodmer's case, every fact is given with date, place and specification, but otherwise such eulogies are more apt to be a matter of personal feeling than accurate history.

There is also a farther objection to any literature that ascribes to one man the origin and development of an art. Such development is always a matter of evolution, due to the energies of many men, and commonly to many countries; and to ascribe all to the first maker, the man who discovered the want, is neither exact nor fair. Then again, the credit given in such cases is not measured by the scope and ingenuity of invention, but by the universality of use that follows. For example, what is one of Whitney's saw-cotton gins compared to a screw-making machine, or a hundred others infinitely more ingenious and complicated, that are confined to special uses, not popularly known.

Eight other leading articles are of emulating excellence; one by Mr. E. H. Williams, on "Geology, from a Business Point of View." will attract attention, in so far as it points out what is every day becoming more apparent, that mineral bodies must be traced geologically.

The author gives some interesting facts in his paper respecting the discovery of minerals, among them the great zinc mines in Pennsylvania, as follows:

"A walk over the mountain to Friedensville, Pa., one day, when farmers were plowing their fields, brought the late Dr. Roepper, well known to mineralogists, to where a team was dragging a plow near the road. A talk with the driver brought out the fact that his farm was cursed with more than the usual amount of stones, and a sample was tossed over the fence to the doctor as evidence. It was recognized as a mass of quartz carrying calamine—a silicate of zinc. The fence was climbed and the two followed the plow forward and back across a field covered with similar masses. Had the doctor been a Yankee he would have bought the farm and died a rich man. As he was only an honest lover of Nature he said a few words to the plowman that transformed an exhausted Pennsylvania farm into the seat of the Ueberroth mine, that set in operation the extensive zinc works at Bethlehem, Pa."

Of Leadville, Colorado, there is the following:

"California Gulch, Col., was a worn-out placer mining town when a man we shall call Jones drifted there. Thousands of dollars had been found and about as much lost; a rough town had sprung up like a mushroom, and like it had disappeared with the exhaustion of the deposit, so that Jones came to a dying town and a worn-out camp. The remaining miners worked in a listless manner at claims that had been exhausted and abandoned, and, whether they made money or not, they all expressed a decided opinion about the "dry bone," as they called a heavy white rock that clogged the riffles of their sluices, and had to be removed by hand, as it was too heavy for water to remove. Jones had not been in luck, or he never would have come to such a place; but he had a slight knowledge of mineralogy and the use of the blow-pipe. He recognized the "dry bone" as carbonate of lead, and his blow-pipe showed him that it was carrying silver in good amount. From that time he prospected for its outcrop, though he pretended to hunt for gold. When discovered on some out-of-the-way corner of the camp he would be trying to find a "color" in dirt of no value, and soon secured the reputation of a fool, and the compassion of the more experienced. At length the origin of the ore was found, and a Chicago capitalist supplied the money to locate and work the claims. After waiting for years, until the owners of the necessary pieces of ground had decided that there was no use in hunting longer for gold, and had abandoned them for Jones to stake out, the world was quietly informed that the much-anathematized "dry bone" was one of the richest silver ores in the world, and, in a day, the butt of endless jokes was lauded to the skies as a wise man and a probable millionaire, and California Gulch, the worn-out gold digging, leaped into vigorous life as Leadville. This is but one of many instances where the glance of an experienced eye found the fortune that Nature had been hold-out to the gaze of blind men for ages."

Other articles on "The Canadian Pacific Railway," "A Permanent Census Bureau," "The Manchester Ship Canal," "Impure Water and Public Health," "Conditions Causing a Cold Wave," are all wholly up to the standard of the magazine.

The Steam Engine.

A TREATISE ON STEAM ENGINES AND BOILERS, BY D. K. CLARK.

PUBLISHRD BY BLAKIE & SONS.

This extensive volume of nearly 1,600 pages is perhaps the greatest work of its well known author, and perhaps the last, if so, a fitting monument to his memory.

We are relieved here from presenting an estimate of the book's value, and describing its authority on the extensive subject to which it relates, by the first portion of Prof. R. H. Thurston's Introduction, which reads as follows:

"The appearance of an exhaustive work on the steam engine, written by an engineer of fifty years' experience, and of unsurpassed distinction in his profession, is an event of exceptional importance to all who are interested in the subject, whatever their station or vocation. To those engaged in that branch of engineering known distinctively as steam engineering, this work will be especially welcome, as including the slowly gathering knowledge of the subject which has been accumulated since the days of Watt, and as giving a compendium of the most recent practice. British mechanics need no introduction to its author; nor, in fact, does the specialist in the United States, or in any part of the American Continent, if of sufficiently long experience to have remembrance of the work done a generation ago by Mr. D. Kinnear Clark, in the establishment of the best practice and the science of the steam engine. Mr. Clark's *Railway Machinery* has been one of the engineer's "classics" since the date of its publication (1855), and his services in determining the nature and extent of the internal wastes of the engine and the laws of their variation, have placed his name beside that of Hirn in Europe, and of Isherwood in the United States, both of whom gained their fame by prosecuting an investigaticn first opened by Mr. Clark in 1850–55.

Since that time Mr. Clark has continued to give his attention closely to engineering matters, and the publication of his *Rules, Tables and Data for Mechanical Engineers*, with its splendid collection of facts and figures, has further shown the nature and extent of his researches. Meanwhile he has also been at work systematizing and preparing for publication the information thus accumulated during a long life of professional practice and research. The result is a treatise crowded with illustrations of the best current practice, and with facts and principles derived from long experience in the laboratories of the physicist, and in workshops of the engineer, and by the scientific investigation of the economics of the completed engine."

To this we will add, that while in common with others, we have in mind an "ideal" work on steam power, there is a want of words, or even want of conception as to what such a work should be, and this paucity of resources we supplement by saying, Mr. Clark's book is much nearer that ideal than anything else that can be referred to. It is not correct to assume that the subject is too wide to be embraced in a single treatise. That is a question of application. Whatever pertains to a personal profession or business should certainly be compassed in one book of reference, as it is in the present case. Even construction cannot be considered separate from performance, and performance is but the experimental part of theory. It is one connected whole, and, as we believe, better arranged and presented in the present case than ever before in any treatise of the kind, an assumption that finds some warrant in the eminent firm that publish the book. It is a subscription book in four volumes, and is sold here at $18.00, which is not a large price for a book of the kind and value. Such works, of necessity, have to command a good price.

The Alessandro Mining District.

THIS pamphlet of 52 pages, with topographical maps, is sent by its author, W. Ham Hall, C. E., who was appointed to report upon the Alessandro irrigation district, a body of land embracing 21,000 acres, lying mainly in San Bernardino County, Cal.

This is the third district that has been surveyed by Mr. Hall, and in some respects shows that the work is easier, or becomes more complete with experience. Not that this was lacking in Mr. Hall's case, because as State Engineer he had mapped in general the San Joaquin Valley counties, and otherwise has given the subject of irrigation much attention.

The Alessandro district was a part of the reorganized Bear Valley Irrigation Company, incorporated in 1890, with a capital of $4,000,000. The irrigation district of 21,000 acres was set off, and it is this which forms the subject of the present report. Water is delivered on each ten-acre tract, at its highest part, the pipes being of steel where under pressure, and of iron stone where there is no pressure. $80,026 has now been expended within the district on water distribution, and the whole can be considered as an advanced example of California irrigation methods. Bonds have been issued to the extent of $765,000, against a valuation of land of $2,436,036.

The Practical Catechism.

Messrs. John Wiley & Sons, New York, send a copy of the above work, by Mr. Robert Grimshaw. Not understanding clearly the "ultimate" idea of the book, an inquiry was sent to the publishers, who send the following communication, which is much better than any notice of the book that we can prepare :

"ED. INDUSTRY — *Sir :* Answering your valued inquiry of the 1st inst., in reference to the 'Engine Runner's Catechism :'

It is not 'a part of a technical dictionary,' as it defines few, if any, words or phrases; further, there is no alphabetical arrangement, save that the various kinds of engines are arranged 'A,' first, etc.

It represents, in some measure, a series of queries which might be addressed by an examing engineer to a candidate for license to run an engine, or admission to the service, although some of the questions are those which have been asked by inexpert or cautious engineers. The author has tried to make it possible for the non-expert to find in it a great number of answers to questions which come up daily, and at the same time he makes it simple enough to give 'Tom, Dick or Harry' no difficulty in getting just what information he wanted in such shape as he can use it. Neither an experienced mechanic, like yourself, nor a college professor, would hesitate to reeommend it as correct beyond suspicion.

It is to help, for example, Smith (who is running a Buckeye engine and is suddenly put in charge of, say a Porter-Allen engine) to handle the latter without exposure of his inexperience.

It is to aid engine runners distant from friends with whom to exchange advice and information to get out of holes without having to go ten miles, or wait a week for answer to written queries.

The catechism plan is chosen because few of the men for whom it is intended know how to dig one fact out from a bank ; they want to know one thing at a time.

The index is unusually full, because sometimes what they do want to know, they want to know right away."

The book is convenient in size, admirably indexed, neatly bound, and costs only $1.50.

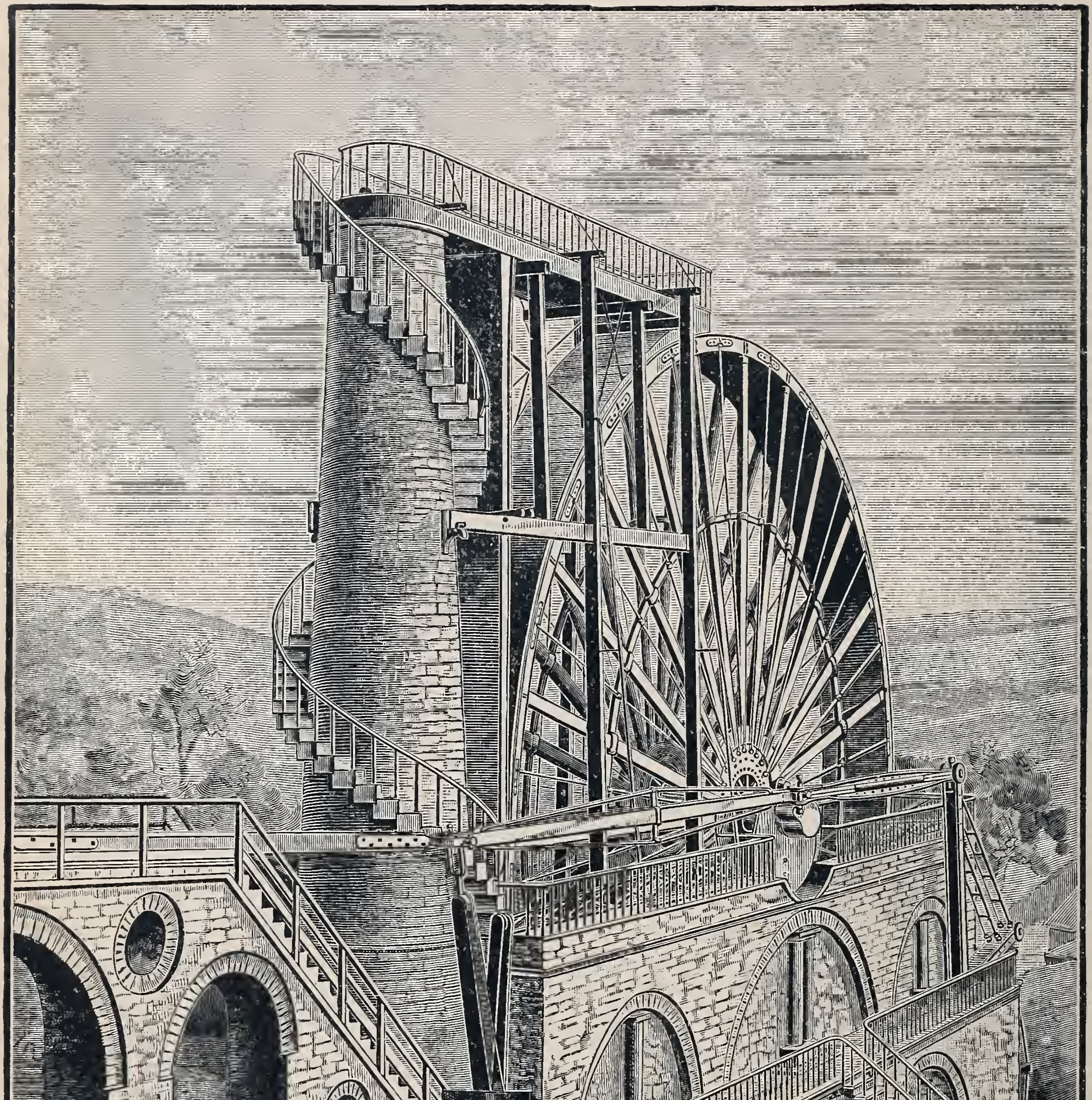
Catalogue of Michigan Mining School.

WE have received a catalogue of the above institution for 1890–91, and are a little surprised at it, that is, are surprised to learn that on the Keweenaw Peninsula there is a school that can boast of all the most advanced means of education in technology and mining, where only 20 years ago the district was, in a sense, separated from the world.

Michigan has always been foremost among states in her educational enterprises, and the environment at Houghton, where the school is situated, is certainly what is required for a mining school.

It is in the great copper district—is indeed in the center of it, where, as at Frieberg in Germany, there is at hand examples of all kinds of mining engineering, mining machinery and a mining atmosphere, so to speak. The curiculum includes instruction, or practice rather, in metrical quantities, which is proper and desirable at this day.

A considerable part of the "review" matter has been laid over from this issue, but will appear in the next number. The failure to receive a number of new engravings promised for this issue, has modified and disturbed the present number in various ways.



THE LAXA WATER WHEEL—SEE PAGE 113.

"INDUSTRY."

JOHN RICHARDS, Editor.

ISSUED MONTHLY BY THE

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A MERCANTILE DIALOGUE.

Scene.—Mills Building, New York. Office of Finance Seer, Esq., of the Associated, etc. Enter Mr. West Shore, of San Francisco, with a roll of drawings, papers, etc.

Mr. Finance Seer.—"Glad to see you, Mr. Shore! You are a long way from home. Got your letter and have cleared away things for a little talk over the subject you mention. When did you arrive?"

Mr. West Shore.—"I arrived yesterday, but have been sometime on the way, stopping at Denver, Kansas City, Chicago and Washington. I wanted to observe the trend of affairs, and how business matters differ from our own. Everything was mixed up with railways. There was railway in everything, down to blacking boots, and as all seemed to emanate from a focal center hereabout, I have followed the scent, and here I am."

Mr. Seer.—"You are right, Mr. Shore; everything is railway now-a-days. Their influence, power and espionage covers all. By suffrance of the American people, who are the most easily imposed upon of any in the world, the railways have 'scooped,'—that's the term they use, Mr. Shore—the money, the laws, the talent, and I was going to say, lands of the country, but we must not waste time. You say you had a commercial scheme to present to me. Before presenting it, however, let me ask why you did not present it in San Francisco? You need not answer, Mr. Shore. That would be wasting your time. You know one must have a little joke now and then. It relieves the tedium of business."

Mr. Shore.—"As intimated in my letter, I want to present some views respecting the commerce of the Western Coast, and especially of San Francisco; also some plans relating thereto, that need promotion and capital. I have notes of various points relating to the volume and nature of trade. Its natural and unnatural lines, and—"

Mr. Seer.—"Excuse me, Mr. Shore, let us waive that; I mean the statistics and facts; you need not trouble yourself about that. We know more about those matters than your people do on the Pacific Coast. Why, not one of your merchants could tell why there is at this time 40 per cent. less goods in your bonded warehouses than there was sixteen years ago. No! Don't trouble yourself, Mr. Shore, on this branch of the subject now. We will discuss it further on, if necessary. What is it you have tangible, and 'in the flesh,' so to speak?"

Mr. Shore.—"I am afraid that in order to explain I must occupy some time and become tedious, but I will do the best I can to be compendious.

In the first place, I will say, our city and its wonderful harbor are playing little or no part in the natural commerce of the Coast. The local products that can come down hill, so to speak, or are drained in by water traffic, are shipped and sent abroad from San Francisco in vessels belonging to other countries that have to come here in ballast for that purpose. Our commerce has but one leg, as one might say, and that leg, thanks to our parental Government, is owned, as I have said, not only by other people, but in other countries."

Mr. Seer.—"Mr. Shore, you are again quoting axioms and facts written up on the very walls here, but I see it is necessary to an explanation of what is to follow. Excuse my interruption."

Mr. Shore.—"When our merchants import anything for local distribution on the Coast, and it is not much now, they enter it at New York, or New Orleans, and bring it by railway to the Coast, paying enormous rates for carriage, and submitting to exactions and rules that have nearly destroyed not only our commerce, but all spirit of independence. What is left is mainly what the railways are pleased to carry through our City from water connections under their control. Of this latter, there is no complaint to make, but it is of little advantage to our City and people, except the few who own the railway. Now, what we need is the other, or inward leg of our commerce, by the sea; so that goods and supplies of all kinds for the 'slope,' as we call it, will come to our ports and be distributed from there without being carried across the continent. Now, to accomplish this, we propose a line, or lines of American-owned steamers, locally-owned as far as possible, but American-owned in any case. We want steamers to run to New York, and steamers to European ports, especially to Liverpool, and I have here with me plans for steamers; also careful estimates of the working and profit of such lines, prepared by an eminent engineer and shipbuilder on the Pacific Coast. It is these things I want to show and explain to you."

Mr. Seer.—"Now you are getting on ground that can be discussed. How many steamers will carry the inner and outer trade of your port? How much will they cost, and why do you think such steamers can compete with the sailing trade that now carries your wheat and other products?"

Mr. Shore.—"Answering your questions in their order, we need ten or more steamers exceeding 5,000 tons capacity. They will cost from six to eight millions of dollars. The third question I can not answer categorically, but will cite you to the present aspect of the world's carrying trade. The great American lakes are an example where steam has triumphed. The long routes to Australia and Asia, where the distances sailed are much the same as from San Francisco to New York or Liverpool, are fast becoming steam routes; in fact, our Port of San Francisco is nearly the only one left for sailing ships, and even now there are signs of the steamers contending for the wheat trade.

At Port Glasgow, in Scotland, the keel is laid for a vessel of 7,000 tons, to be impelled mainly by steam, for the San Francisco wheat trade. The fine clippers now in the trade will, no doubt, remain for a long time, but sooner or later must succumb to steam, and to our steamers, if we get them."

Mr. Seer.—"Mr. Shore, I must admire, or even praise your arguments and views. The scheme is a good one—a first-class one, and will pay, and now comes my turn to do a little speech making.

Just across that hall, in some offices within call, there is an association, we will call it, or perhaps aggregation will be a better term, of four hundred millions of dollars of trans-continental railway interests. Just hold your breath and see if you can get any kind of mental conception of what four hundred millions of dollars is! Do you know whether it would be a houseful, a steamer load, or a street full? But no matter, we can get at it another way.

Suppose you had your steamers done, worth eight millions, your investment would be just two per cent. of the railway interest. Suppose next, that this trans-continental interest was damaged, or even threatened by your steamer line. They would just call up your shareholders and say, 'steamers are a risky investment; they sink sometimes; wear out pretty fast, and are out of sight and reach most of the time. Now, just hunt up some safe place where they will not foul and anchor them, or what is better, send them off into some other traffic, and we will pay you eight per cent. per annum on your investment. You can send here every three months for a two per cent. dividend and it will be ready. You will have no risk, no trouble about strikes, no revenue laws or custom house clearances to bother you.'

Suppose this, Mr. Shore, and then figure out the cost to the railways. The annual amount to be paid to your ship company would be $640,000. The quarterly dividend would be $160,000, and the amount each year would be about 'an eighth of one per cent.' of the other investment, or what is called investment. How does that strike you?"

MR. SHORE.—"It looks astounding. It would pay, no doubt, to do such a thing, but is it possible or probable?"

MR. SEER.—"You have not been out long enough yet Mr. Shore from the land of weather, orange groves, and your somnolent City. Pay! Do you think the carrying from San Francisco Bay the only stake being played for? There is the great southwest that raises half the cattle for one thing, and products that can only be estimated by thousands of tons, that these railway lines carry across the continent to be shipped from Atlantic ports. You have heard, perhaps, of a southwestern deep-water harbor convention at Topeka, and, later on, one at Denver, to promote the establishment of an outlet for these products at Galveston or Indianola, perhaps not, though. You don't hear much out in San Francisco of these things.

These conventions are all bosh, in so far as accomplishing anything. The same eighth of one per cent. that will squelch your ship lines, will, at the same time, stop the Southwest Harbor scheme at Galveston, Velasco, at the mouth of the Brazos River, too, where some people are dumping a few millions just now, under the delusion that the people across the hall will tolerate any such interference with their interests and plans."

MR. SHORE.—"But, Mr. Seer, is there no patriotism left, no regard for the country as a whole—none of that spirit left which founded and built up our country? Is there then nothing but a scramble for personal ends? Has trade and commerce, as we call them, become nothing but a pool of corruption?"

Mr. Seer.—"No, I will not assert nor admit that, but the spirit of our day is one of pure selfishness. The government, the fountain head, in its national polity, sets the example of one man eating another's bread. The people cannot be blamed for following, but we are not able to discuss the ethics of this thing now, only the facts.

You have a strong coast line of ships out in your country, managed by men of high moral integrity and unquestioned business honor. They have over twenty ships, I think, not very valuable ships because only worth about $75,000 a piece as taxable property. Two of the principal ships of the line, and, I think, one of the smaller ones, are now anchored in Richardson's Bay, near your City; a nice quiet place, safe from storms, and pretty safe from the sight of inquisitive people. They are not out there to cultivate barnacles upon, barnacles are of no value. What are they there for Mr. Shore, do you know?"

Mr. Shore.—"There because since the boom in Southern California the freights have fallen off, so there is not freight enough to pay the traffic."

Mr. Seer.—"Where are you staying in New York, Mr. Shore? Excuse another joke. I must have one now and then, and I warn you to look out for dropped pocket books, the man who met you in Milpitas, and knew your father in the Western Addition. Mr. Shore, excuse me, you are verdant. These ships over in Richardson's Bay are earning more than those in commission.

Just apply the principle of that mathematical scheme I worked out a few minutes ago to these ships, and see how much your only railway company would have to tax their investment to pay for the use of these ships, or their non-use I should say, but the railway people do not do any such thing; the people at Los Angeles, San Diego, and elsewhere along the Coast foot the bill, and not only foot the bill but pay for the privilege.

The railway gets the freight now, there is no other means to convey it, and they not only add to the rate enough to pay for these idle ships, but a dollar or two on each ton to make sure, and pay them for the strain on their conscience. They are good men, I mean morally good, and do you suppose a man is to wrench and abuse his conscience for nothing?"

Mr. Shore.—"I am astounded. I never thought of this, and never thought of other ports being in the same condition as our own."

Mr. Seer.—" There are none in the same condition, that is, none with a city of 300,000, built up and equipped for commerce. Look at Galveston! The government engineers have been there for half a generation, fooling around to deepen the channel, and have only deepened the disgust of all well-informed people with their pretended efforts. Why there is less water on the bar there now than there was at the beginning, and now they modestly ask for seven or eight millions more to go on with the work. The fact is the railway interest knows that the Galveston scheme is a safe one, and that no deep water port is likely to be made there, hence it is a safe place to keep the engineers at work, and the government's money is well spent, because they might fool around and open a channel somewhere and then there would be more steamers to pay out, moor or send away. The railways can stand a good deal, but it is not necessary. They do not have to buy their way, except in small cases like yours, for example. They have another means of killing water traffic, but you must excuse me, it is time for luncheon."

Mr. Shore.—"I am amazed, Mr. Seer, and must go to the hotel to sit down and think. I want to hear more of this matter, however, and beg that you will continue the subject at some other time."

Mr. Seer.—"Certainly. Come in any time about ten. If I am engaged, one of my clerks can give you the information. It is not hawked about, but it is kept in the safe, so to speak, but we will divide up with you with pleasure. Now, as a joke, don't pick up any pocket books on your way back to the hotel, and do not mention weather or hydraulic grants, you might be imposed upon. Good day."

WAGES IN MEXICO.

It was hoped that space could be afforded in this issue of INDUSTRY to publish in full the late essay of Minister Romero on "Wages in Mexico," contributed to the January number of the *North American Review.*

The article is written in an able and scholarly manner, and indicates not only a consummate knowledge of the facts in the case, but a clear grasp of the economical problems attending on the subject. Minister Romero has long been a resident of this country, and represents the highest authority that can be named on the subjects treated.

The article, as a whole, is a strong argument in proof of a proposition set forth in these pages for three years past, that wages are very nearly uniform the world over, when measured by their product, and that the amount of wages—not the rate—is the true thing to be considered in all economic problems into which the subject enters.

The Department of Public Works, which is a very important bureau of the Mexican Government, has for some time past been diligently collecting data respecting labor and wages, and finds that in twenty-nine States of the Republic "field wages," or laborer's wages, average 36 cents a day.

The highest rate is in Sonora, where it is set down at 65 cents a day. In some States it sinks to an average of 25 cents, with a minimum of 12½ cents in Hidalgo, and 30 cents in Sonora. In Lower California it is uniform at 50 cents a day.

In respect to rate and amount of wages, Minister Romero says:

"It is a fact that wages in Mexico are far lower in many cases than those paid for the same industries in the United States; but this ought not to seem strange when it is considered that this country pays probably the highest wages in the world; and not even the foremost manufacturing nations of Europe, as England, France, Germany and Belgium, can compete with it in this regard. Yet, while it is true that labor in the European countries is not so well remunerated as in the United States, it must be taken into account that it does not produce there as much as it does here. I am assured by competent persons that a bank-bill printer, for instance, does not print in England more than 1,500 sheets per week, while the average work done by the American workman is 6,000 sheets per week; and it is stated in the *Journal des Economistes*, that a French weaver can take care of only four looms, a Belgian of five, an English weaver of six, and one from this country of eight. But the actual production during a given working time is in Mexico far less than in the United States, or even in Europe. The day's work of a Mexican laborer very likely represents only one fourth of what is accomplished during the same time by a laborer in the United States. A Mexican laborer working from ten to eleven hours a day, for instance, accomplishes less work, or produces less, than a European or an American laborer in nine hours, and in some instances the disproportion is as great as 1 to 5. I have been assured that a Mexican bricklayer in eleven hours' work does not lay more than 500 bricks, while a bricklayer in the United States lays 2,500 in nine hours; and that a Mexican weaver cannot attend to more than two looms. Under such conditions the high wages of $3.00 a day paid in the United States are no higher than the wages of 50 cents paid in Mexico, so far as the product of labor is concerned."

In respect to the cost of living, which is directly connected with this subject of "rate" of wages, the statistics furnished are surprising, showing that the necessaries of life cost nearly double as much in the City of Mexico as they do in New York. We select from tables given, a few of the principle articles:

Articles.	*Prices in the City of Mexico.*	*Prices in the United States.*
Iron (pig)	$32.00 per ton	$19.00 per ton
Coal	16.00 "	3.18 "
Flour	.05 per lb.	.01½ per lb.
Bacon	.50 "	.20 "
Coffee	.22 "	.19 "
Ham	.50 "	.18 "
Pork	.11 "	.05¾ "
Paper (printing)	.15 "	.05 "
Salt	.07 "	.04 "
Sugar	.21 "	.05 "
Tobacco	.24 "	.06¼ "
Cotton prints	.10½ per yard	.03⅘ per yard

Minister Romero explains that these prices are due, not only to a very high federal tariff on commodities imported into Mexico, but also by reason of internal tariffs between the States, or assessed by States, in addition to the National tax, and he comments as follows on the system:

"When economical errors of long standing prevail in a country and become imbedded in the people, the most effective way to eradicate them is sometimes to make their remedy a subject of stipulation with a foreign country, giving it thereby a special force; otherwise, if the remedy is enacted by one Congress, another can repeal that measure, as has been the case in Mexico with the *alcabalas* exercise. We have great respect for international agreements, and hold that the legislative branch of the Government cannot abrogate them, unless with the consent of the other party, or in case of war.

It is now time to show that the low wages paid in Mexico do not produce cheap commodities, and could not, therefore, by competition, lower the compensation of labor, or the cost of similar manufactured articles in the United States.

We pay at home, in several cases, wages amounting to about a sixth of what is paid here for similar work, and yet the production in Mexico, with such low wages, is a great deal more expensive than the production of similar articles in the United States, with probably the highest wages in the world, and with prices consequently higher.

It is true, that wages are one of the principal factors in the cost of production of all kinds of merchandise, but they are not the only, and in many cases not even the principal one. The question of wages is very complex, and it seems that, in comparing the wages of this country with those paid in Mexico, two important factors are overlooked: first, the cost of living in each country, or the purchasing power of the currency in each; and, second, the amount of commodities produced in each country by the same unit of work, either on account of the greater fitness or greater physical strength of the laborer, or through the use of machinery, which increases the amount of production and cheapens it enormously. When these two circumstances are taken into account, it will be found that the high wages paid here are often no higher for the work performed, perhaps in some cases even lower than those paid in Mexico and in other countries; and only in that way can we explain how this country with its high wages can produce many articles—for instance, watches and clocks—which compete successfully with those made in Switzerland, where wages are comparatively low."

After going over a number of articles to show that their high price does not promote their manufacture, Minister Romero refers to printing paper as follows:

"It is much the same with manufactured articles, like common printing paper, which in the United States is worth about 3 cents a pound, and in Mexico 15 cents, although we have abundant raw material and water power for its manufacture. To encourage the making of paper, we established an import duty on foreign unsized and half sized paper of 10 cents per kilogram, or over 5 cents per pound, equivalent to over 100 per cent. ad valorem, which was reduced by our present tariff to 5 cents per kilogram for the unsized, keeping the duty of 10 cents on the half sized paper; and notwithstanding this, we import printing paper from this country, where the wages are so high compared with ours. Something similar happens with cotton and cotton prints, the former being worth 5 cents per yard in this country, and from 10 to 15 cents per vara of 33 English inches in Mexico, and the latter, which are sold here at 8 cents per yard, being worth in Mexico about 20 cents per yard."

On smuggling, there are some suggestive remarks applicable to the opium traffic in this country, with the difference however, that opium is much easier to smuggle than tobacco, being less bulky in proportion to value.

"A very suggestive instance where high duties encouraged smuggling came under my personal observation. Mexican tobacco could not reach the northern States of Mexico on account of the high rates of transportation, to which I have alluded, and it could not be raised close by, because its culture was for several years a government monopoly. Therefore the inhabitants of that region used tobacco raised in the United States, which they bought at a moderate price. Our import duty on tobacco up to the year 1878 was $1.25 per kilogram, or about 66 cents per pound, and although tobacco from the United States was consumed in all the frontier of Mexico, and that was the only tobacco imported in the free zone, which at that date was limited to the State of Tamaulipas, and although the yearly importation exceeded one million pounds, yet there hardly appeared in the treasury any revenue collected on this article. At that time I had the Treasury Department of Mexico under my charge, and, having observed this fact, I obtained the sanction of the President, who then had full authority from Congress for that purpose, and reduced the duty on tobacco to the comparatively moderate amount of 16 cents per kilogram, or less than 8 cents per pound; and from that time we derived some revenue from foreign tobacco. I could mention many other instances as forcible as this one."

The duties collected on merchandise imported into Mexico in 1889 were 84.7 per cent. of the value, which is very nearly twice the rate collected in this country for the same year, that being 44.4 per cent. What such a method of collecting revenue will eventuate in there, it is hard to foresee, but one thing is sure, it has, as Minister Romero shows conclusively, neither increased wages nor founded skilled manufactures in Mexico.

EXTRACTS FROM A NOTE BOOK.

[BY "TECHNO."]

No. XIII.

————The Red Annex, mentioned in my last notes, has been investigated, and instead of containing, as I supposed, some peculiar machinery, there was only a squad of boys, ranging from five to fifteen years of age. They were orphans, and I was not long in finding out what my Uncle was hinting at. These boys are joint "wards" of the Government and of the works with which their building is connected, and the scheme of their care and education is one worthy of the "long heads" these northern nations have given evidence of in their social economy.

The boys are taken by the Government and domiciled in the Red Annex, under a contract with the firm or company owning the factory, in which the factory furnishes buildings, heating and perhaps food. The Government furnishes instruction, in the way of schooling, maintains discipline, and conducts the moral part. The works furnish implements and material for working, and the two go on together.

The boys make toys, baskets, rugs out of pine shavings, and a hundred more small things of wood or iron that do not require much skill. There are forges, work benches, and the usual paraphernalia of a shop, but mostly of a miniature kind. The food is plain, very plain, but wholesome and enough. The work is also plenty, and there is no idle time there, in this embryo shop. Discipline is kind, but like the laws of the Medes and Persians is inflexible.

The main point of all, however, is a romantic one. The energy and success of all human efforts depend upon some end in view, some goal to be attained, and there is here such an object. Between the school and the works is a mysterious door through which the orphans, after certain qualifications, pass on into the works and become full apprentices. To gain an entrance at this door is the dream of all. For that object no labor is too hard, no effort too great. The mysterious door is then in view, a perpetual talisman, and as a moral agent has more power than all the mottoes, maxims, lectures and the like that were ever invented.

It is a fact there present within grasp, and means a great change of life, more privilege and elevation to a new sphere, in short, is, as my Uncle claims, the most ingenious educational expedient the world has ever invented.

After passing the "Red Annex" and his term in the works, the boy or man goes out into the world an educated mechanic, an independent man, to add to the working force of the Nation. He has not, at any stage, been a charge upon the country, that is, felt or worth considering. He has not suffered from being an orphan, indeed the reverse in most cases.

———— I find here a wonderful number of things of a similar nature that could be written about, some of them technical, as will appear, but for the present will lay them aside. The factory was a curious one in many ways. The timber, which was all received as logs, was small, crooked, and such as would be called "culls" at home, but out of it was made the most perfect joiner work that I had ever seen. The knots were like the spots on Joseph's coat, and in order to secure panels for doors, clear of knots, they had to be bored out with "bung saws" and cores driven in the holes. In sawing, the logs are not as with us guided by carriages, but are sawed with grain and shape, by gang saws with continuous or roller feed.

The board or plank, no matter how crooked when sawn, becomes straight when piled up and seasoned. The saws are thin, not more than twelve gauge. They run at a terrific speed, and as the feed is slow the sawing is smooth and accurate. All sawing of whatever kind, except, perhaps, scroll sawing, is done better than at home, with thiner saws, truer and fast enough. The finishing processes, that is, the joiner processes, I have made copious notes of and will write them out in due time.

———— My Uncle came in from Marstrand on a fine little steamer of the Swedish type, late in the evening, that is, late by the clock. The sun is no guide here as to time. He gets in about twenty hours of service above the horizon in this latitude, and a little further up, in Sweden, stays up all night for a few days in June. It seems queer to go out at 11 P. M. and sit down to read a newspaper. Marstrand is a kind of summer bathing place about twenty miles out in the "Skärgord," or "rock garden," as the Swedes call it. The whole coast for miles out to sea is sprinkled with rocks, the surface being about two thirds water and one third granite, and navigation here becomes a science.

The little steamers are seen everywhere, taking the place of omnibuses with us. They are cheap, complete and ingenious, all of the screw type and built of iron. They are reversed with an eccentric that is mounted on a shell with a spiral key or feather that throws the eccentric forward or back about thirty degrees to the "angle of advance" either way, and the engines have less pieces than any reversing ones I have ever before seen.

My Uncle was in fine humor when he came in, and busy contending with a Scotchman concerning drinking in Sweden, and laid down the facts about as follows: — "There are no teetotal humbugs here, no horrid examples printed on tracts, moral lectures and the rest, nothing of the kind, but, instead, a law that regulates the matter and forces the rum trade to be respectable. This country, like all other Northern ones, has been cursed with drunkenness, especially among the peasantry and the poor. Their liquors are usually only a remove from vitriol in strength, and the climate creates an appetite for alcohol as fuel. They fired up in a fearful way, up to and beyond human endurance. The surplus energy was not expended, as in Ireland, in cracking heads, or as in America by raising sheol. It produced joy first and then stupefaction.

The Government stepped in and took the liquor traffic in charge. You have heard of the 'Gothenburg Law.' That means that only responsible and respectable people must sell liquor, and must sell it only in a respectable place, and if anyone wants to drink they must do it in a respectable way. The least abuse or infraction of the law means a revocal of license and some other person is appointed.

There are commissioners of some kind that have the whole matter in charge, and they keep it in charge. No liquor, no rows; no rows, no lawyers and police machinery, why you can hang your coat on the bridge there and you will find it tomorrow morning just where you left it."

The honesty of the people in these Scandinavian countries, especially in the northern or inland regions, is a familiar theme with my Uncle. He had, many a time before our coming here, told me of the absence of crime and absence of lawyers, which he seems to think are either a sequence or a cause of disturbance.

One of his "lectures," which I noted down and which I expect to hear again, is in substance as follows:

"Lawyers, courts, contention, thievery, murder, crime and the rest, of which there is eternal preaching, teaching and scolding, is not the normal or natural state of people. Look at Gothenburg. You may walk until you are tired to hunt up a lawyer's sign. Never heard of but two there, and they have nothing to do in the way of criminal practice, except to defend foreign sailors. They have a prison there with about twenty convicts. No one gets in there unless they belong there, and no one gets out of there until the end of their sentence, unless to be buried, and most of them get buried. People don't fool with law here. That is a settled matter, moves like the tide when it moves at all. You can not go to law here if you want to in any civil case. The first thing is arbitration by a governmental or appointed commission of respectable citizens. These act like a court, less the humbuggery of one. There are no technicalities, habeas corpus and the rest, only common sense and finding out the facts. Nearly all disputes end here and there are no fees.

Such an institution in England or America would save one third of the Nation's revenue. They have to save it in Sweden, they have not got it to spend, and don't want to if they had. Sometimes the Criminal Court in Gothenburg is not opened in a whole year, and this in a city of 75,000 people. Talk about civilization. Goths and Vandals, better take some lessons from them. They have hammered out Republican Government, self denial and true courage into various people of the earth, and have still on hand a store of good qualities that may be imitated."

I have found out since here that there is a good deal of affinity as well as mixture between the Scotch and Scandinavian people. They live on opposite and not distant sides of the North Sea, and once, or indeed many times, were "mixed up" in war matters. The Faroe, Shetland, and other islands have people mostly Scandinavian in lineage, and the language is, I am told, a Norse patois, so my Uncle has, no doubt, inherited some of his opinions of Northern nations.

(To be Continued.)

THE GREAT GRAVITY WATER WHEEL.

LAXEY, ISLE OF MAN.

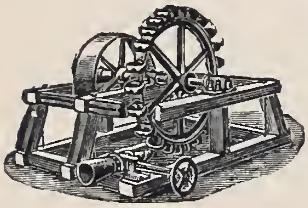
[See Frontispiece.]

As mentioned in our issue of November, last, the Pelton Water Wheel Company has engraved, in a very fine manner, the celebrated Laxey water wheel, employed for pumping purposes at the lead mines on the Isle of Man.

This very perfect piece of work was constructed nearly forty years ago, and, it is claimed, has never been stopped since that time, except for painting or making connections. We have seen it going on irreverently on Sunday, which, in the Isle of Man, is kept in the true Scotch style, and made a day of misery as far as possible. It must, however, be explained that this is unavoidable, as the wheel must run to keep the water down in the mines. The wheel is what is commonly called an "overshot" one, which, as a name, is neither elegant nor relevant. "Gravity wheel" is a better name, because the action is one of gravity, the water being loaded upon and descending on one side of the wheel, thus operating by weight alone.

The water rises in the masonry tower from a conduit under ground, which brings the supply from a small stream that comes down through the valley above. We are informed, however, when there, some years ago, that the wheel "pumped its own water," which if true would be a remarkable circumstance indeed. The wheel is narrow and of great symmetry, as can be seen, and does not as we infer, perform more than 150 horse power of work, which is transmitted several hundred feet to a shaft of the mines by means of links or motion rods, they may be called, made of wood and trussed with iron rods to give stiffness. These rods or beams are supported at their ends or joints on small cars or trolleys having wheels about 24 inches diameter, running on iron ways so that friction is nearly eliminated. The stroke is 20 feet. The crank, seen in the foreground, a rejected one, is 10 feet between centers.

An object of the Pelton Water Wheel Company in engraving this wheel is to show the great change in practice during 40 years past, not only in respect to the nature of the water wheels designed then and now, but the still greater change in the extent and cost of permanent plants. The available head of water for the Laxey water wheel is, at least, 80 feet, and were it not for a limit in the wheel's diameter it might be more, but assuming this as the head, the little



Pelton Water Wheel in the margin, which looks like an ornamental letter at the beginning of an article, will give out the same or more power. Both drawings approximate a scale of $\frac{1}{200}$.

This seems marvellous. The efficiency of the Laxey wheel, taking its resistances into account, and the angular velocities of the descending water, cannot be more than 65 per cent. of the theoretical work. The little water wheel, on the contrary, will utilize at least 20 per cent. more, and the original cost will be so much less that comparison will only be absurd—one to fifty perhaps.

Reverting again to the drawing, it shows very well the appearance of the country behind, or in the background. The drive out to Laxey, about seven miles from Douglas, the main port of the Island, is one of the finest to be seen in Europe. It skirts the seashore, or rather is on the cliffs all the way, and when the weather is clear the view is enchanting.

Few American travelers go there. The Island is too small for them, but anyone who will spare two days for the trip will be well repaid.

THE ACTION OF PROPELLERS.

Mr. Hiram S. Maxim contributed to the *Century Magazine*, in October last, an essay on "Aerial Navigation," or, to be more exact, on the mechanism of such navigation, and mentions an article written some years ago by Richard H. Proctor, in which it was assumed that "birds, in flying, did not exert anything like the power which some scientists had supposed, and that the advantages of moving forward rapidly on new and undisturbed air were such that a bird did not exert power greater than that used by some land animals in running."

Professor Proctor, when in America later on, made careful observation of the flight of buzzards in Florida, and declared from these observations that such flight could not be accounted for except upon the hypothesis that the wings did not rest upon the same air long enough to set the air in motion.

In some remarks made last month, occult causes affecting the flight of birds were mentioned, and this remark of Professor Proctor was in mind at the time, but it is, perhaps, wrong to call these causes occult, although they may not be understood.

Professor Proctor's remark respecting "moving forward on to fresh, undisturbed air," shows that he detected the mysterious principle, if there be one, that lies at the bottom of still flight, or flight without a lapping movement of the wings.

The same obscure causes apply, to some extent, in navigating water, and may, no doubt, lie at the bottom of the fact that forty years of experiment and computation have not determined a theoretical form for screw propellers.

Notice of this matter here is to call attention to the same principle as applied to screw propellers, moving forward on to undisturbed water. Outside of mathematics and the formulæ applicable to the action of screw propellers, there are certainly phenomena that are not embraced, otherwise there would be no question as to the best form for these wheels, and the problem would be ended. Instead of this there is a wonderful diversity of both theory and practice, and propellers are made in all kinds of forms, having only helical faces in common.

An inference is, that a screw moving forward at high speed, and in contact with undisturbed water, operates much as it would in a solid nut. A plain illustration is furnished in striking the surface of still water quickly with an oar or flat paddle, also in the use of an oar. If, for example, an oar is dipped in the water when its supports are not in motion, and is jerked forward at the speed of a screw vessel, the oar would be broken off the same as if the blade were in a solid and the fulcrum fixed. This may be an unscientific method of reasoning, but the immobility of water at various velocities of progression through it, does not seem to be a common element in formulæ relating to screw propellers, and is certainly that element on which our friends of aerial flight are counting for the suspension and propulsion of air navigating apparatus.

CONSTRUCTIVE MECHANICS.

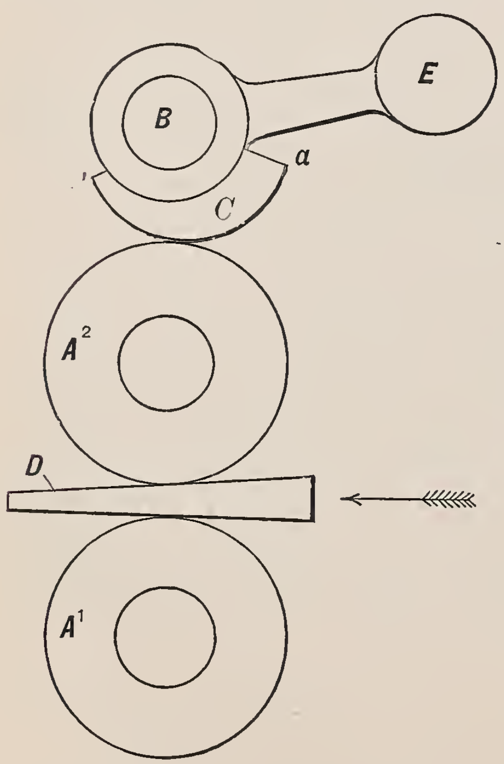
No. XXIII.

TAPER ROLLING MACHINERY.

A good many years ago, twenty-five, at least, there was constructed in Middletown, Conn., a machine for rolling plane irons, or other taper forms, on the method shown in the diagram below.

A^1 A^2 are common cylindrical rollers. The lower one is set firmly in bearings on the bottom of the housing, or frame, in the usual manner, and the upper one is left free to slide up or down with its bearings, which do not even sustain its weight. Above and parallel to these rollers is placed the forming one *B*, to which is attached the die, or shaping form, *C*.

D is a tapering piece passing between the rollers, and *E* a weight heavy enough to turn the roller *B*, and return the die *C* to its initial position after a piece has been passed through the rollers A^1 A^2.



The operation is as follows: Supposing the machine out of use, the top roller A^2 falls down and rests upon the lower roller A^1. The die *C* being out of contact with the top roller, swings around by means of the weight *E*, until the point *a* is directly over the center of the main rollers, but clear of the one A^2, to the extent of the thickness of the thin end of the piece *D*.

As soon as the piece *D* starts, which can be at any point, the top roller A^2 is raised and comes in contact with the die *C*, which then starts by friction in an opposite direction from the piece *D* and follows at an equal rate, giving its shape to that piece until it passes out of the rolls. Then the top roller A^2 being out of contact falls down on the lower one, and the form, or die *C*, and the roller *B*, swing back, ready for another piece.

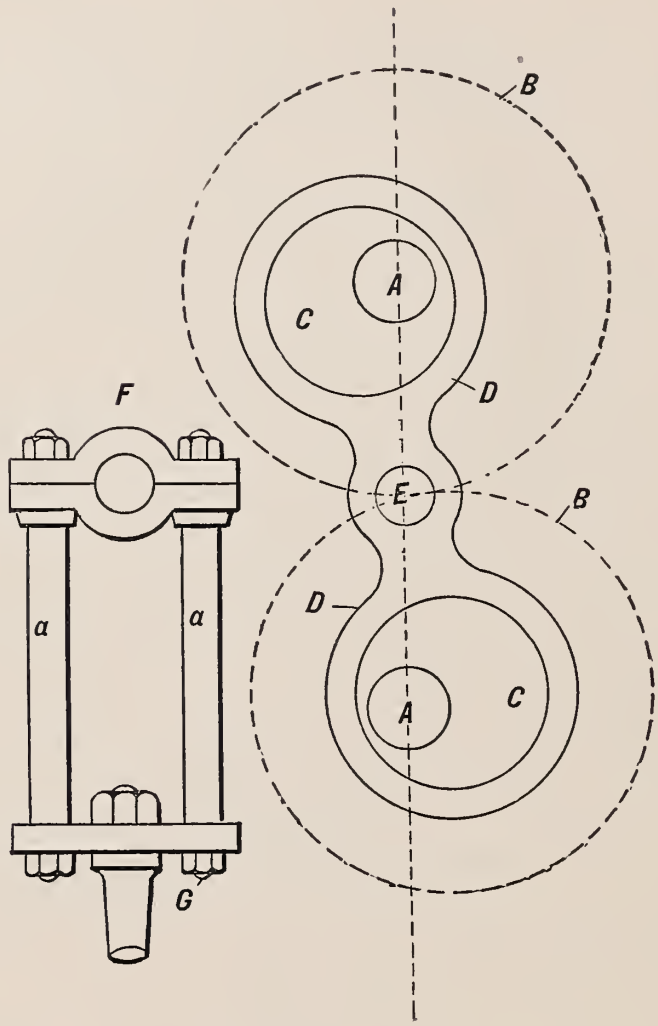
The extreme simplicity of this construction is not its only merit. It dispenses with all feeding mechanism, because the piece *D* can be fed in at any point, and relieves the operator of all care in watching cam action, or other period contrivances. Not only this, the die *C* is easily and quickly changed without disturbing the main parts of the machine. The main rollers are plain cylindrical ones, and all adjustments are the same as those for a common pair of rollers, which indeed the machine represents, except as to the forming attachment at the top. No special patterns are required, except for the dies, and these can be of common iron, cast true enough on their outer faces, so as not to require finishing.

These claims for the system are based on practical experience in making and working such machines, which performed for years without failure, and the present notice of them is suggested by the appearance recently of a taper rolling machine with eccentric, or taper faces, formed on the main rollers, and a "time" feeding apparatus of a good deal of complication for starting the piece at a particular point of the roller's revolution.

Another advantage of the three-roller system not mentioned before, is the speed of performance. Pieces can be fed in as rapidly as the weight *E* will fall, or the shaping roller swings to its starting position. In a case where this method of rolling plane irons was adopted, the capacity was trebled, and the accuracy of the work increased at the same time.

GRINDSTONES.

It may seem a simple matter to engage the attention of constructing engineers, but it will be a favor if some one will inform INDUSTRY why grindstone frames are made of circular form, concentric with the stones. It costs more for pattern work, looks as badly as can be, and takes away the base where the frame is to rest on the floor. If such frames or boxes are made rectangular, they become symmetrical, can be flanged at the floor, and will stand firm. The corners make a safe lodging place for anything that may fall in, and the box will hold twice as much water as if made circular on the bottom. The common grindstone box or frame bears a strong resemblance to a soap kettle including its legs, or standards, and has a perverse faculty of tumbling over with the strain of a belt or other cause. In a few instances that have come to notice such frames were made rectangular, and the impression was that it was "right" in every sense. It may require more iron, but not much, and is worth some iron.



AN EXAMPLE OF CRANK GEARING.

Mr. F. M. Cazin, writing in *Electric Power*, on the subject of electric apparatus in mining and metallurgic industries, describes a method of operating, and producing rectilinear motion for pump rods that is both ingenious and practical in a high degree, and possesses some features that call for notice.

The mechanism can be explained by the diagram above. *A A* are two shafts positively geared together by spur wheels indicated by the dotted lines *B B*, consequently revolving in an opposite direction. On these shafts are two eccentrics *C C*, set with their extreme throw so as to be connected by the member *D*, which embraces both.

In the center of this connection or member *D*, is attached at *E* a pump rod or connection, which will receive a reciprocating rectilinear motion equal to the throw of the eccentrics. The pump connection is made with a four-stud "straddle top," as indicated at *F*, which shows one side, the rods *a a*, four in number, joining in a rectangular plate to the center of which the pump rod *G* is attached.

There is nothing new in the geometry of this movement, and not much new or of value for operating mining pumps by electricity, in which connection the description is given, but there is something new and valuable too, in the device for other uses.

Where high pressure occurs, as in the case of punches, presses, and the like, there would be double the bearing surface by reason of the two eccentrics, which is quite an object and equal to reducing the pressure on the surfaces one half.

The force is applied in the center of the shafts, between their bearings, consequently balancing the strains each way. The four straddling studs terminating in a plate below is a strong and convenient construction for connecting and operating the rams of high pressure pumps, or the sliding heads of punches, shears, or presses of any kind. There is, besides these features, an avoidance of slides or guides, and the friction resulting from them.

These are considerable claims for this much machine gearing, but they will be borne out in practice.

It is common here on the Pacific Coast to employ eccentric gearing for high pressure hydraulic pumps, with either a cross-head and guides, very long connecting rods, or both. In one case, that at the Palace Hotel, the pump rams are attached to "Scotch yokes," guided on the outside by wide bearings, which produces diagonal strains that demand very strong proportions to resist.

SECTIONAL BOILERS.

U. S. COAST DEFENSE VESSEL MONTEREY.

CHARLES WARD, CHARLESTON, W. VA.

In 1888 the Navy Department, in view of the success of the Belville sectional boilers in French vessels, and for other reasons, which were set forth in the report of Chief Engineer Melville last year, determined to adopt such boilers in some of the war vessels then projected, and to that end issued a circular inviting makers of such boilers to furnish examples to be tested by the Navy Department.

Certain conditions as to the adaptation of the boilers were imposed, and strictly adhered to. Among these conditions was an allotted space in the *Monterey*, of which drawings were furnished to those who wanted to enter into competition, and an examining board was convened consisting of Chief Engineer Chas. H. Loring, Chairman; Chief Engineer W. A. Windsor; Past Assistant Engineers, J. J. Barry and and C. P. Howell, U. S. N. These conditions of testing the boilers provided that it should be done at the New York Navy Yard, or at the maker's works as they might prefer.

Four applicants tendered boilers for these tests, but it seems only two were considered and experimented upon, those of Mr. Charles Ward, of Charleston, West Virginia, and Mr. William Cowles, of New York.

We will include, in this notice, only a few of the "quantities" of the tests. They are elaborate, and perhaps as thorough as any that have ever been made with steam boilers of the kind. The following are the conclusions of the board in their report to Chief Engineer G. W. Melville.

New York, Navy Yard, May 23, 1890.

Sir: "The tests of all the coil boilers offered under advertisement of the Honorable Secretary of the Navy having been completed, we respectfully submit the following as "the conclusions of the Board upon their relative merits" in the several respects enumerated in the order of the Honorable Secretary convening the Board.

The evaporative efficiency is based upon the amount of water which, under the conditions of the tests, would be fed to all the boilers that the space allotted to the ship will contain, this quantity being multiplied by Q. This method disposes of the question of the

Secretary's order, "the dryness of the steam." We find these values to be relatively 1.086 for the Ward, and 1.00 for the Cowles.

The relative weights are as the water used as above, divided by the weight of all the boilers respectively, as given in our reports. These values we find to be 1.186 for the Ward, and 1.00 for the Cowles.

The weight of the contained water is so nearly similar in both boilers that we give no values to the difference.

In the matters of accessibility, ease of making repairs, and simplicity and interchangeability of parts, we consider that the Ward boiler has a considerable advantage over its competitor. We think it scarcely necessary, however, to carry any spare parts with either boiler, except, perhaps, a manifold or two, 10 or 15 per cent. of all the tubes may be removed without materially affecting the economy at natural draft, or even under a small fire-room pressure.

In ease of firing they are equal. For the care of the feed the Cowles has a great advantage over the Ward. We think one man could attend the feed of the six Cowles boilers as easily as he could two of the Ward, though the liability to damage from fluctuations of water level in the latter is small.

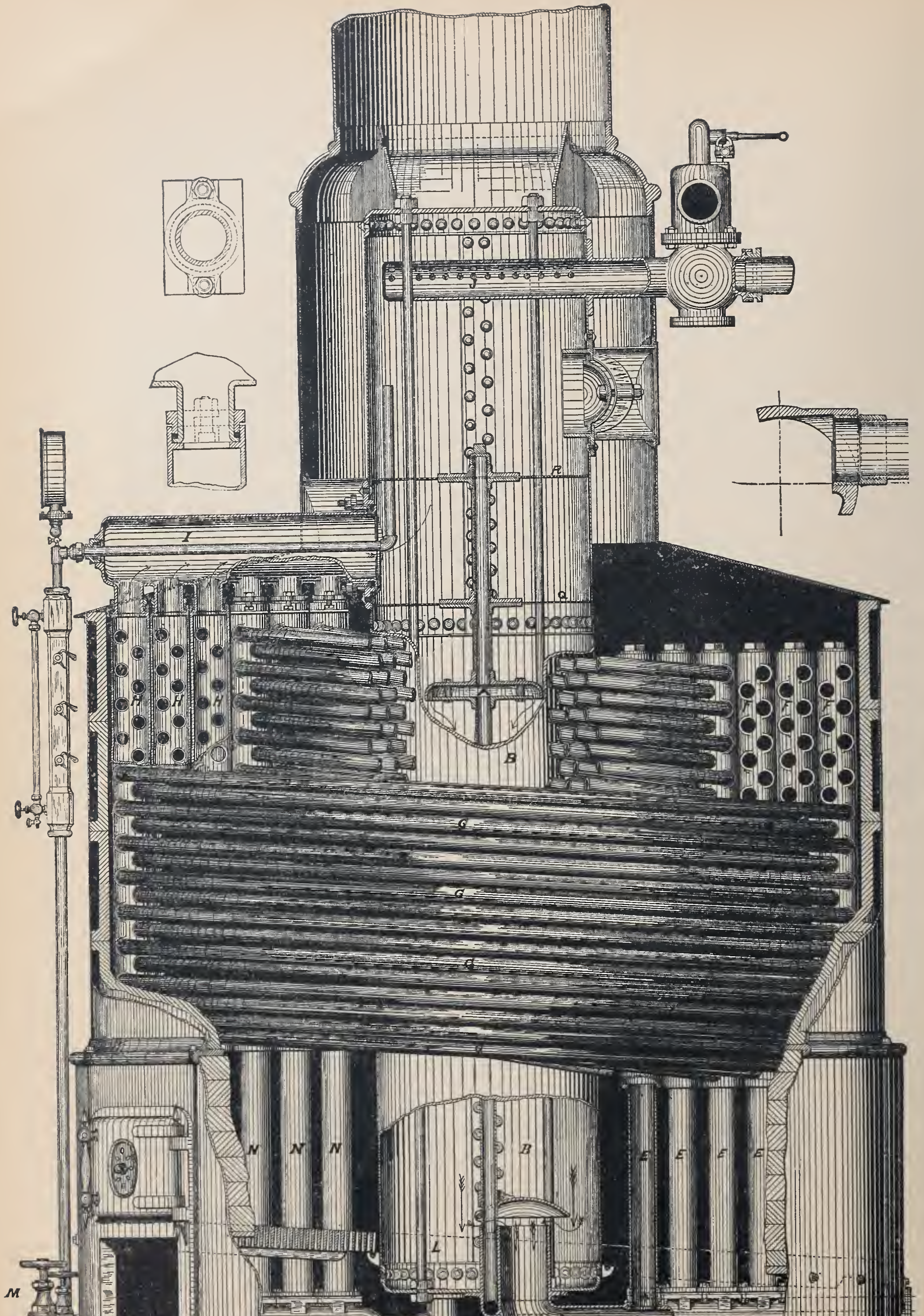
Both boilers will work well in battery, as both have done. In "durability and the capacity of long continued steaming, without cleaning," we think they are equal.

We desire, in this connection, to repeat the opinion expressed in our report on the Cowles boilers that only tubes of the very highest character should be used in such boilers, and the suggestion that those of seamless-drawn make should fill all the requirements. Even at the high price asked for these tubes at present, the cost of a boiler of either of the styles tested, if fitted with them, would be far less than that of a Scotch boiler of equal capacity. The only objection to their use is that, as yet, none are made, in this country, of steel." Very respectfully,

CHAS. H. LORING
Chief Engineer, President Board.
GEO. W. ROCHE,
Chief Engineer, U. S. Navy, Member.
GEO. W. MAGEE,
Chief Engineer, Member.
J. J. BARRY,
Past Assistant Engineer, Member

The amount of fuel consumed per square foot of grate surface in the Ward boiler, tested at Charleston, West Virginia, was 55.04 pounds. The evaporation, per pound of fuel, was 6.5 pounds of water. This statement is independent of colorimetrical qualification, and is a kind of average.

On this finding the Navy Department ordered Ward boilers to be fitted in the coast defense vessel *Monterey*, now nearing completion at the Union Iron Works, in this City.



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The engraving on the opposite page is a partial vertical section through one of the *Montery's* boilers, respecting which Mr. Ward sends the following explanation :

"The feed water being introduced at *H* or any convenient point, is conducted by an internal pipe (having an inverted "rose" *A* on its end), to the center of main cylinder *B*, where, in its slow descent in small jets, it becomes heated by contact with the surrounding water, and at once precipitates the mud into the bottom of the drum *L* before entering the tubes.

The generator being filled to the proper water line and fire introduced, it is evident that the heat developed is rapidly absorbed by the water in the tubes *G*, which, becoming rarified and expanded at once, pours over through manifold *I*, into the central cylinder *B*, causing an active circulation to and from the same through the lower horizontal manifold *C*, vertical manifolds *E E E*, generating tubes *G*, and upper manifold *I*.

This forms a continuous circulation of the water, the rapidity of which is accelerated by the development of heat and the increased demand for steam, thus making the heating surface more active in proportion as the fires are forced, and the demand for steam increased, which not only facilitates increased generation of steam, but secures dry steam by presenting an ever changing current of water laden with heat, ready to form steam on reaching the central cylinder.

The heavier remaining water descends again to make the circuit. Any tendency of the water to follow the steam to the steam pipe *J* is prevented by a perforated diaphragm introduced in the center cylinder *B*, just above the upper horizontal manifold *I*, causing the steam to rise through numerous small holes over the area of the cylinder.

To avoid the disastrous result of unequal expansion and contraction every individual piece is free to expand and contract independent of any other.

By removing the cover of the smoke box and the upper manifold *I*, any of the piles of circles may be *raised* out of the jacket for examination or repairs and replaced in a short time.

The half circles or tubes are connected to vertical steel manifolds by right and left hand steel bushings, which may be easily renewed at a small cost. (See small cut, upper right hand corner.)

These generators have been thoroughly tested with success, during the past eleven years, on steamers and tugs, and are inspected by U. S. Inspectors and tested to 300 lbs., and allowed to carry 200 lbs. steam pressure.

The cleaning of these boilers is accomplished by first blowing off the mud through the valve *M*, and afterwards flushing the tubes by opening the mud valve *O*, which draws the clean water through the manifold *C*, vertical manifolds *E E E*, tubes *G*, down through the vertical manifolds *N N N*, horizontal manifold *P*, and mud valve *O*, thus perfectly cleaning the tubes should any dirt remain in them."

A few years ago the subject of water tube and sectional boilers admitted of discussion, and also of doubt, under the circumstances then existing, but since then the requirement of high pressures, due to the introduction of highly expansive engines, and the improvements that have arisen in the construction and adaptation of this class of boilers have given them a permanent place in the power economy of the world, and as Chief Engineer Melville last year pointed out, a special adaptation to war vessels, where a rapid generation in a small space and with a minimum weight of water and boiler are desirable features.

We cannot help a word of commendation for Mr. Ward, who, from an unexpected part of the country, had the confidence to enter into these tests and secure the contract for the *Monterey*, and it will be further fair to say that whatever the particular result with the present boilers, he will, no doubt, from them learn a better adaptation for future cases. Of their generating power and compactness there is no question, and these, with fair endurance, make up the main essentials for vessels that are called upon for the exigencies of naval warfare.

IRRIGATION ON THE NILE.

The extension and development of irrigation works in Egypt, is taking a place among the great engineering works of the world. The inspector general of the irrigation works, Lieut.-Colonel Justin C. Ross, has recently made a voluminous report on the Nile works, segregating the different districts and showing the extent of works and expenditure in each.

Some opinion can be formed of the extent of irrigation works in Egypt from the following quantities, taken from the report above named. The irrigated area cultivated is 565,744 acres, or 8,840 square miles, extending along the River Nile for a distance of 525 miles. The population of the irrigated country is set down at 5,879,431, and the revenue derived from the government from water tax and rented lands was in 1890, $25,422,735.

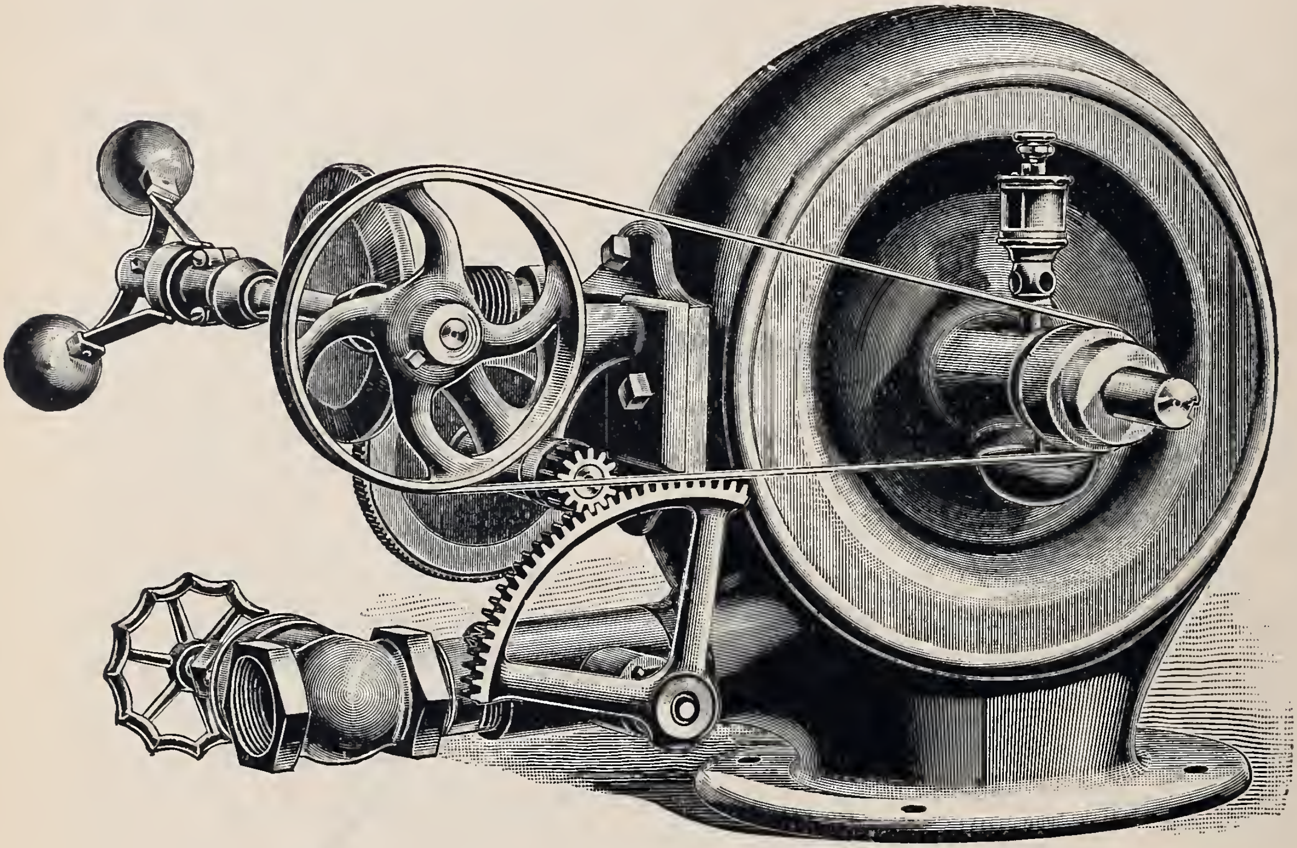
The lands are cultivated in various crops. 200,000 tons of cotton were exported in 1890, forming one fourth of what was consumed in Great Britain. In 1890 the engineering operations involved the removal of 20,000,000 cubic meters of earth work.

This development of the valley of the Nile is one of the present great schemes of the English people, who are at the head of it all, and most of the profit will, in the end, find its way to London. It amounts to a commercial conquest of Egypt, and in the next disturbance in the map of Europe, or perhaps sooner, this old country will fall under the dominion of the British, in fact, as it is now in effect.

Irrigation in Egypt is, however, a different matter from irrigation here. It is not water alone but fructifying manure that is furnished by the Nile water. The river begins to rise early in August, and it recedes in October, the period of flood water being only two months or so. During this time the "red water" deposits a coat of silt or mud all over the land, and at the same time saturates the soil to meet the requirements of the crops. The silt or mud is washed down from torrential streams in the mountains of Abyssinia and contains as nearly as possible the elements required by the sandy soils of the great valley.

There is no rain in Egypt; no frost, or other physical impediment to a regular recurrence of crops, so long as Nile water can be procured to irrigate the land. This kind of water and silt renewal or maintenance of lands is not unknown in this country. On the upper Ohio river, for example, where the flood waters rise from 40 to 60 feet, much alluvial land is overflowed each year, and as the freshets last for a week or more, and the water heavily charged with silt washed down from the Allegheny mountains, there is a deposit of slime or "slickens," as we would say here in California, from 0.5 to 1.5 inches thick, the same as on the Nile. This slime is not "slickens," however, but a rich fertilizing compost mainly vegetable in nature, that, when mingled with the soil, produces enormous crops year after year, and without exhausting the soil in the slightest degree.

This sort of water renewal occurs in the valleys of the Scioto, Miami, Wabash, and other tributaries of the Ohio, where the still "back water" covers the land, and there are no currents to wash away the slime or mud after it settles.



SELF-GOVERNING PELTON MOTORS.

THE PELTON WATER WHEEL COMPANY, SAN FRANCISCO.

The above drawing is taken from one of the latest improved hydraulic motors made by the Pelton Water Wheel Company, with a throttling valve and centrifugal governor to regulate the speed under varying loads. The design is complete and pleasing, the parts being "self contained," as our English friends say. The centrifugal governor moves the two bevel friction pinions at the top, to the right or left, as the speed determines, and these drive the wheel gearing either way, moving the toothed sector in front, and a wing valve to which it is attached, so the pressure or amount of water is adjusted to the speed of the wheel, and the resistance of the work. The company have sent out more than four hundred wheels during the past year, and are continually improving or "refining" them, as Professor John E. Sweet would call it.

REPORT OF THE BUREAU OF STEAM ENGINEERING.

GEO. W. MELVILLE, CHIEF ENGINEER U. S. N.

Chief Melville's report for 1891, outside of its statistical sections, is brief and of much interest. The first section dealing with the repairs or maintenance, shows that the *Baltimore* and *Charleston* have a mileage of more than 20,000 knots each, and a difference of only 157 miles. The repairs on the *Baltimore*, judging from the list, were at least twice as much as on the *San Francisco*, which speaks well for her builders, the Union Iron Works.

In speaking of the equipment at Mare Island Navy Yard, Chief Engineer Melville says:

"The great want in this yard, as in all the others, is the means for handling and transporting heavy weights. No thought appears to have been given to this either in the location or arrangement of many of the shops."

This is true, not only of navy yard shops, but of nearly all others in this country where the labor of handling is so dear.

In respect to the engineer corps, it is again necessary for the chief engineer to present, in a still more forcible manner, the fact that the engineer corps is inadequate. We quote from that section.

"THE ENGINEER CORPS.— It is with regret that I am again compelled to report that the number of engineer officers is insufficient for the proper performance of the duties belonging to them, and to emphasize the fact that unless measures are at once taken to remedy this condition and to stop the steady decrease in numbers, we shall before long have a painful awakening by a serious breakdown or accident on some of our vessels. There is a limit to even a naval engineer's endurance; and while the officers of the engineer corps will do their best to make all needed repairs and keep in efficient condition the magnificent machinery of the new vessels, from which the country justly expects so much, and in which it takes a proper pride, they can go no further than the limit of their physical strength; when this has been reached the machinery must take care of itself.

I fear that the conditions which obtain with modern high-power machinery, and the duties which come upon the officers charged with its maintenance, are not thoroughly understood by Congress, and in explanation will state that the machinery of a modern war vessel is a collection of mechanisms, each composed of many parts, and forming as a whole a vast and complicated organism which may be rendered useless by accidents to parts that might seem unimportant to the non-professional observer; added to this is the fact that it is not a mere labyrinth whose key once learned makes everything easy, but a moving, almost living, organism, whose integrity depends upon the perfect working of each little part. The only thing that will insure this perfect working is the constant, unremitting, personal care and inspection of the engineer; it will not do to leave it to subordinates; they can, under proper direction, do the manual work needed, but if the engineer, by reason of his other duties, can not look after the principal details, they will inevitably be allowed to take their chances until an accident shows that they have been neglected.

It is easy to see, in view of the foregoing, the condition of nervous strain which must come upon conscientious officers too few in number to give proper attention to details, but fully aware of the risk which is incurred. They go on with their work as faithfully as they can, but in constant dread of an accident for which they feel they should not be held responsible, but for which they may be made to suffer the implied disgrace of a trial by court-martial, or the imputation of neglect of duty. Not long since a slight collision occurred between two naval vessels, which was directly traceable to lack of sufficient engineer officers. It cannot, therefore, be a matter of surprise that engineer officers are breaking down from overwork, or resigning to escape it. Indeed it has been sometimes claimed that, by reason of this nervous strain, engineer officers age more rapidly than others, and should be retired earlier in consequence. * * *

The number of engineer officers should be at least 300, and even this number will be inadequate unless supplemented by a sufficient number of intelligent and skilled artificers and well-trained firemen. The division into grades should be in accordance with the duty to be performed, and, as far as practicable, arranged so as to give reasonable promotion, in order to keep the ablest young men in the corps. At present we are constantly losing bright and promising young men by reason of slow promotion and overwork.

I would also recruit the corps both from the Naval Academy (with a suitable engineering course as referred to later), and from competent graduates of the great technical schools and colleges under regulations to be formulated by the Department. I believe that many advantages will result as a consequence of drawing our supply of young officers from both these sources."

In respect to quarters and accommodation, the chief engineer renews his protest of last year in the following words:

"It is again urged that action should be taken looking to the abolition of the steerage. Although the existing laws and regulations seem to provide that all officers of the rank of ensign shall live in the steerage, and consequently make one or more cruises as occupants of this apartment according to rapidity of promotion, practically, assistant engineers are the only officers, with rare exceptions, who are ever in the steerage for more than one cruise. Officers of the Medical Corps are promoted to the wardroom after three years' service and rarely spend the whole of that time on a cruising ship; only one pay officer is attached to a ship and, being thus head of a department, is in the wardroom; ensigns become ward-room officers when made "watch and division officers," which can be done by the commanding officer of the vessel. But nothing avails for the assistant engineer, and he may make two or even three cruises in the steerage, while he sees officers of other corps who entered the service long after he did, and are his actual juniors in rank, enjoying ward-room privileges; he, meanwhile, shares a common apartment with a number of cadets who are his juniors in age by from ten to fifteen years. This is manifestly a grievous wrong, and could not have been intended when the law was passed which says 'ensigns are steerage officers.' I do not ask that anything be done to put any officer back in the steerage who can, by any construction of regulations get out of it, but I earnestly recommend the abolition of the steerage. It is a relic of barbarism, and is as much out of place on a modern ship as would be a slow match for the guns; it is productive of the greatest discontent, and is an injustice to officers who are charged with important and responsible duties. Where the number of engineer officers on board ship is so small as at present, it is inevitable that they should be up and around a great part of the night, and to preserve their health they should have a room where they may rest when off duty in the day time. I can conceive no reason why all commissioned officers should not be members of the ward-room mess, and I earnestly recommend that the Department take such action as will secure this most desirable end."

The subject of firing is treated extensively, and in the chief engineer's usual terse style, of which the following is an example:

"First, the fireman should be taught to fire. There is an opinion altogether too prevalent among persons otherwise well informed that anybody can shovel coal into a furnace, and that that is all that is required of a fireman; also, that the mere fact of putting a man in the fire room and giving him a shovel somehow or other turns him into a fireman. There never was a greater mistake. While it may not take as long to become a proficient fireman as to learn one of the ordinary trades, it nevertheless does require an apprenticeship and considerable experience. This is true, even with the conditions of natural draft and but 12 or 13 pounds of coal burned per square foot of grate per hour; with forced draft and 40 to 50 pounds of coal burned per square foot in the same time in large boilers, and 80 to 100 in small ones, the conditions are necessarily much more severe. A raw recruit looking into the seething mass of flames in a furnace under forced draught, can tell nothing as to the condition of the fuel, but the trained fireman sees at a glance just where the coal should be put, and will guard properly against one great source of danger, bare grates at the back of the furnace."

In respect to mechanics in the engineer's force there are offered a good many wholesome suggestions, showing that this branch of the service has suffered some from either favoritism or incompetency in the apppointment of "artificers," as they are called in the British navy. The following is selected from that section of the report:

"The mechanics of the engineer's force are machinists, boiler makers, blacksmiths, and coppersmiths. Proficiency in these trades can only be acquired by a thorough apprenticeship, which must be passed in regular work in the shops on shore. Their special adaptation to the needs of the Navy will come from experience on board ship, and a man who has learned his trade or handicraft can, in a comparatively short time, learn the modifications necessary for ship work. I wish here to again emphasize what I have so often said before, that no men should be appointed to these ratings except those who can show, by a thoroughly practical examination, that they are expert handicraftsmen. Formerly it was not an infrequent occurrence for a man who had been an unusually good fireman to be promoted to one of the mechanical ratings as a reward for good conduct or proficiency in something else. Such a system was wrong then, and would be worse now with the much greater amount of machinery of much greater complexity on board a modern ship."

Of contract trials, the chief engineer says of the *Concord*, *Bennington* and *Newark*:

"They have been subjected to the usual four hours' trial under forced draft, and while there were trifling mishaps which made a second trial necessary in each case, they were in no sense serious, and the machinery of all three proved well built and entirely satisfactory.

The *Concord* and the *Bennington* are exact duplicates, and they are identical with the *Yorktown*, except that they have closed ash pit forced draft, instead of that by closed fire rooms, and a different style of air pump.

The failure of the *Concord's* first trial was due almost entirely to the inexperienced fireman, who allowed the backs of the grates in some of the boilers to become bare, thus permitting the cold air from the ash pit to strike the tube sheets and cause leaky tubes. There was also a difficulty in securing an ample feed supply, due to faulty arrangement of the feed pipes. The second trial was a complete success in every way.

The *Bennington's* first trial was stopped by the breaking of the piston rod of one of the circulating pumps; everything else had worked perfectly. The second trial, which took place the next day, was entirely satisfactory."

From some remarks in this connection it seems there is a strong preference for ash pit forced draft, instead of "stoke-hole pressure," and there is no doubt that either the closed ash pit or else some induction system must supersede the closed fire room. Also in the same connection is a very lucid explanation of why there is a greater fuel economy in merchant steamers than in war vessels, as follows:

"An interesting comparison of the conditions of the two cases is furnished by the *Baltimore* of our Navy and a merchant steamer called the *Iona*, which have about the same displacement—4,450 tons. The *Baltimore's* machinery develops 10,000 I. H. P.; that of the *Iona*, 700 I. H. P.; the *Baltimore* has room for only 17,000 square feet of heating surface in her boilers with a ratio to grate surface of less than 30, while for the *Iona* the figures are 3,160 and 75. The *Iona* works always at full power and secures a speed of about 8½ knots; for this same speed the *Baltimore* would require more power on account of the friction of the enormously larger engines. But the great economy is in the boilers. With the enormous amount of heating surface for the power developed, the *Iona* can evaporate 10.5 pounds of water per pound of coal, while the *Baltimore* probably does not exceed 8 pounds. The *Baltimore's* boilers weigh 490 tons for 10,000 I. H. P., and the *Iona's* 122 tons for 700 I. H. P. Were the *Baltimore's* boilers built for economy instead of power on the same ratio as the *Iona's*, they would weigh 1,743 tons, or nearly twice as much as the entire machinery of the *Baltimore* does. The comparison was made between these two ships purposely, because they are supposed to be of the best English design.

In other words, economical machinery means heavy machinery taking up much room; but the power required in swift war vessels of moderate size is so great that to make the machinery both powerful and economical the whole ship would have to be given up to it. As the great requisite in our ships is powerful but light machinery, economy must of necessity be sacrificed."

There is cause for regret or even alarm at the chief engineer's remarks upon steel castings for engine parts. The charges of mistaken assumption and failure on the part of steel makers are direct and vigorous, winding up, however, with some encouragement as follows:

"I am loath to believe that we shall be obliged to permanently abandon steel castings, for if the processes of manufacture can be improved so that absolute reliance can be placed on the product, the question of light machinery for war vessels is rendered much easier of solution. Moreover, it has always been found possible in other promising lines of work to ascertain the causes of first failures and to remedy them, and I am inclined to believe that in time this will be done for steel castings, since one firm has already successfully produced forms that the other makers said could not be cast, and their manager has stated that it is simply a question of time, and the education of superintendents and workmen before we can safely count on the production in cast steel of any form now made in cast iron."

We do not reproduce more of this section because it abounds in facts with which this Journal has nothing to do, except in their technical bearing, but we strongly suspect that either by shorter or more careless methods, we are not attaining in this country all that can be done in casting steel. One is forced to this conclusion by the fact of the very extensive use of steel in engine parts, and for naval work generally, in Europe. Some years ago, when visiting the Elswick Works, Sir William Armstrong, Mitchell & Co's, at Newcastle, England, there were very few iron castings to be seen in these great works, nearly all were of steel. There were pieces of all forms, and while complaint was made of "varying hardness," nothing was said of "wasters."

Whatever opinion may be formed of the Bureau's opinions and procedure in respect to steel castings, one thing is sure, they are candid and honest.

The Appendix to the Report contains tables of an elaborate test made with a Thornycroft steam boiler, and horse power trials of the steamer *Cushing*, which is fitted with boilers of this kind; also tests of manganese bronze at New York, and tests of a steam launch, showing an evaporation of 5.80 to 7.52 for anthracite coal, and 6.80 to 7.57 for bituminous coal, which is a poor result even for a launch.

SOLID PISTON VALVES.

The *Teutonic*, White Star steamer of the first class, when in New York some months ago, had the rings removed from the piston valves of her engines, and directly afterward made her famous run, breaking the record from New York out. There is, no doubt, a good deal of lost power consumed by the friction of stiff piston rings. There is no way to prevent over pressure when adjustable packing is employed, and this is one of the main reasons in favor of snap rings, or non-adjustable ones. It is a problem of fitting, and the character of materials. Every one with much experience will have at some time, if not many times, met with sliding joints under steam that show no wear or symptom of it. The fact is we do not know all concerning the wear of surfaces under steam, but do know that when pressure is inconsiderable, as in the case of piston valves of vertical engines, and when the metal is uniform in respect to expansion, positively fitted parts do not wear. If a main steam cylinder, or a valve chamber, can be "bored true," and that means a good deal, and a piston can be made with a certain fit therein, no change will take place, and friction will be nearly eliminated.

THE SAN FRANCISCO'S SHAFTS.

To The Editor of "Industry."

Sir:—In the last issue of your paper I noticed a paragraph in regard to the shafts of the United States Cruisers which is misleading, and would tend to convey the impression that the *San Francisco's* shafts were made in Europe, which is not the case. The *Charleston's* shafts were made by Krupp, at Essen, Prussia, because at that time no establishments in this country were capable of making a steel shaft of the length and quality the specifications required.

The *Charleston's* crank and propeller shafts are 12¾ inches diameter with a 4½ inch hole in them, this hole was drilled through these shafts, the object being to obtain an inspection of the center of the shaft to see if there were any defects in the center which did not come through and show on the outside.

In the U. S. Ship *San Francisco* the crank shafts are 14¼ inches diameter with a 7 inch hole in them, and her propeller shafts 14½ inches diameter with a 9 inch hole in them. These shafts were forged hollow on a mandrel. The *Charleston's* were drilled because it is impossible to forge a hole in a shaft smaller than 6 inches diameter.

The *San Francisco's* shafts were forged at Bethlehem, Pa. Made of fluid compressed steel, forged under Whitworth compressor, and finished complete.

The shafts of the *Monterey*, of *Cruiser No. 6*, and the battle-ship *Oregon* are all being made in America. Only the shafts for two cruisers, the *Baltimore* and the *Charleston*, were made out of the United States.

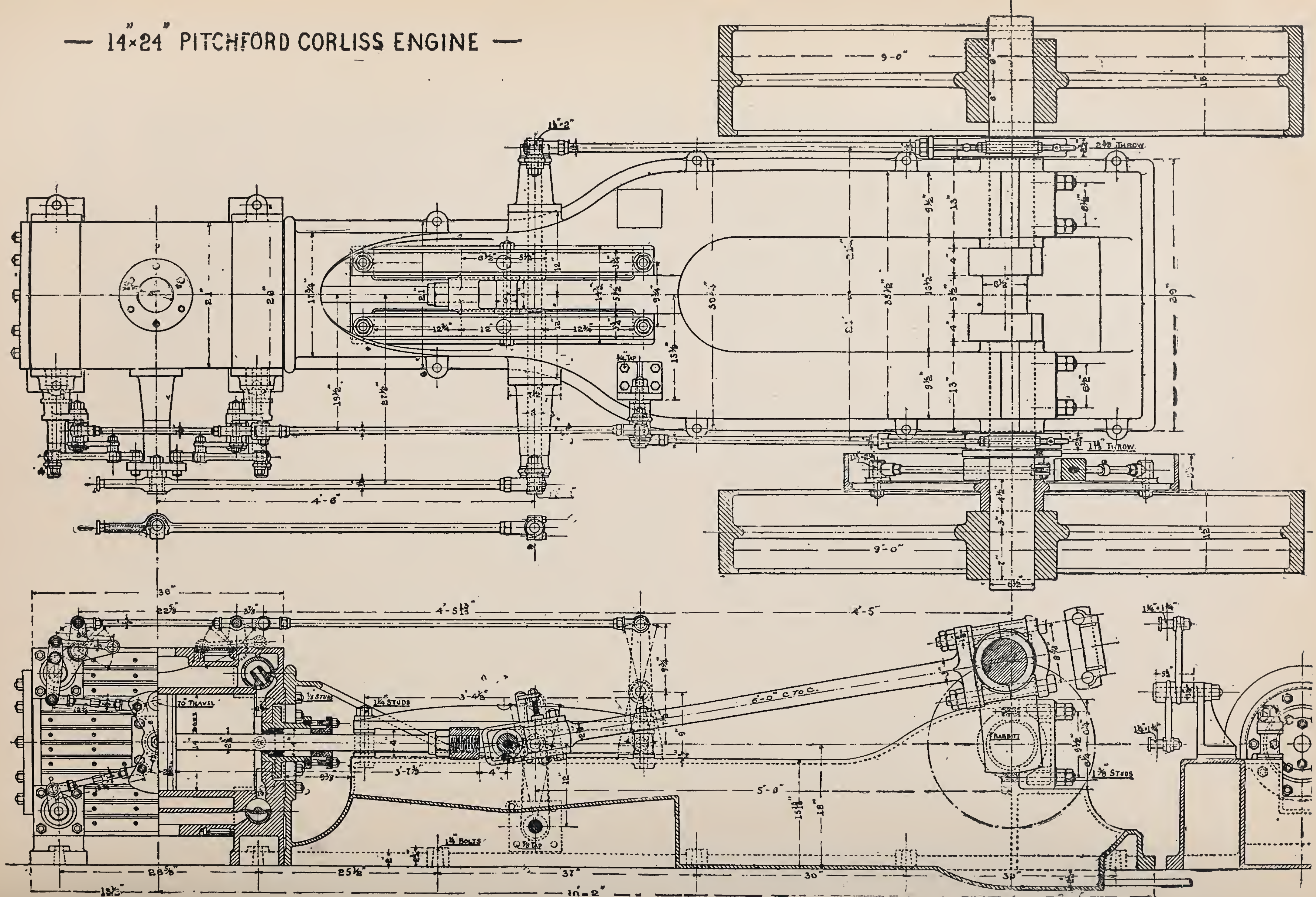
The demand for these shafts of a high quality justified the Bethlehem people in erecting forging facilities that are superior to any in the world, and the quality of the shafts made at Bethlehem has surpassed, in almost every instance, the requirements of the Government, and there had to be a special requisition addressed to the Secretary of the Navy requesting permission to use them. For instance—The *Charleston's* shafts test 68,000 pounds tensile strength per square inch, with an elongation of 27 per cent. The *San Francisco's* shafts have 73,000 pounds tensile strength and 31 per cent. elongation; as the Government requirements were 68,000 tensile strength and 27 per cent., it required permission to put in the better shaft, because it was so much better than anything that had been produced in the world that it exceeded even the margin of variations allowed by the Government.

The Bethlehem Forge Company have two Whitworth forging compressors, one of which is the largest Whitworth ever built. They have a fluid compression plant with all modern furnaces, and a steam hammer of 125 tons weight of falling parts, 14½ feet fall, the face of the die being 10 feet 3 inches, which is larger than any hammer in any other part of the world. Yours truly,

Irving M. Scott,
Union Iron Works.

San Francisco, Jan. 22, 1892.

— 14"×24" PITCHFORD CORLISS ENGINE —



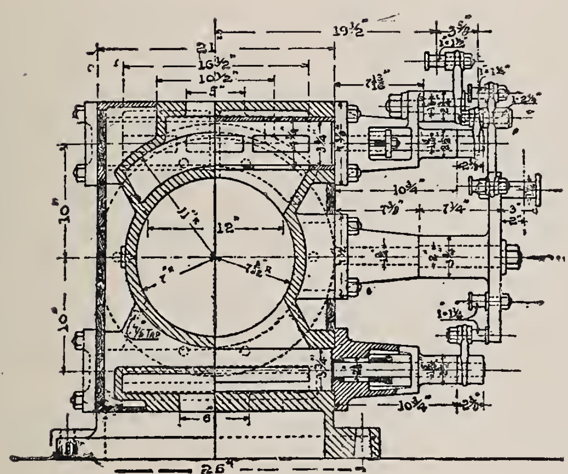


FIG. 2.

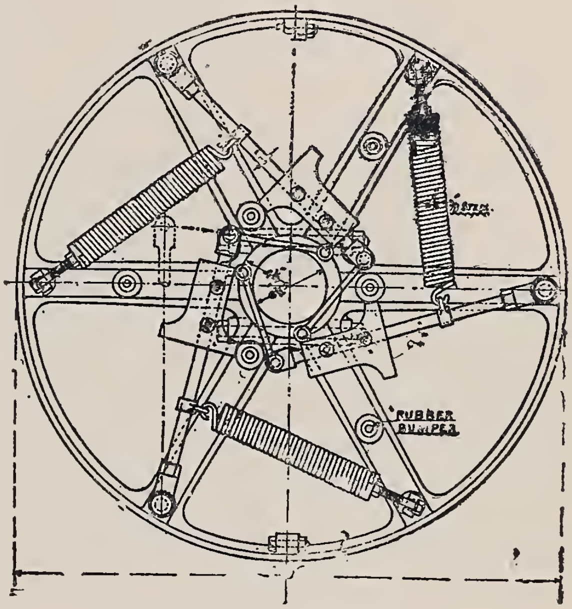


FIG. 3.

PITCHFORD-CORLISS ENGINE.

MESSRS. W. T. GARRATT & CO., SAN FRANCISCO.

In the last issue of INDUSTRY there was published a perspective elevation of a Pitchford-Corliss engine without the usual valve releasing gearing, and we are now able to supply working drawings of a similar engine, with the principal dimensions in figures.

On the page opposite is a plan and longitudinal view, partially in section, also a partial cross section taken between the main journals and crosshead guides. Fig. 2, above, is a rear end view, partially in section, through the rear inlet and exhaust valves, and Fig. 3 is a side view of the governor.

There is a chance here for several pages of detail description that would not be of the slightest use to steam engineers, and neither of interest nor use to others. The space will be better occupied by some remarks upon "reading" drawings, which may have value to students and apprentices, the present case furnishing a good example for that purpose.

The drawings are photo productions from the actual sheets by which the work is constructed, and embodying all except the kind and quality of the materials, that any skilled engineer or mechanic wants to know in order not only to understand, but also to estimate the weight, cost and power of the engine, and how it is constructed.

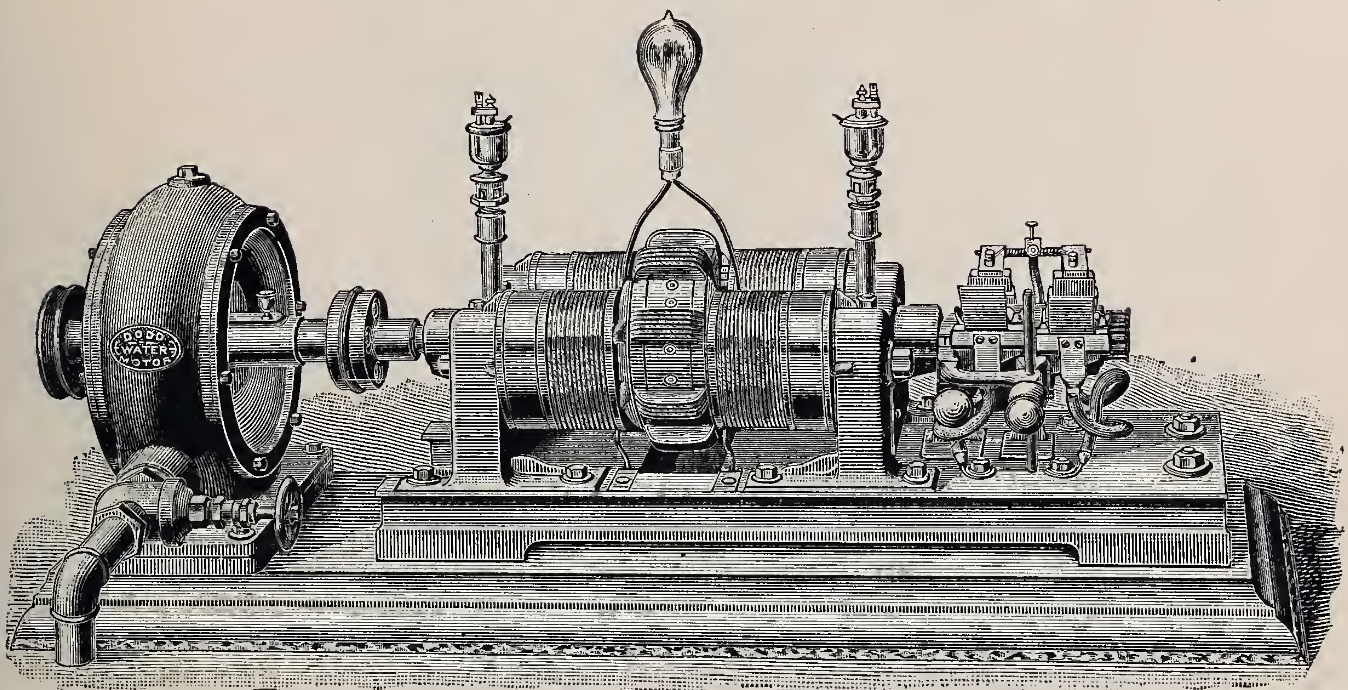
The main thing in following such a drawing is to always keep in mind two or more planes. Either one of the views taken alone will convey nothing in a complete way, unless for parts that are known to be cylindrical in section, so every detail must be looked at in two planes to be understood. This is the puzzling part to beginners. They are accustomed to seeing things in perspective, both the real objects and, in most cases, pictures of them, and it requires a little training, but not much, to become familiar with true projection.

If, for example, one is actually looking down on the top of the engine shown here, in the plan view, all rays would diverge from the point of sight, and no part, except at one point, would look as it is represented in the drawing, and if the engine were drawn as it would appear from one point, such drawings would be of no use to work from, because there would be no scale for dimensions, and the parts would be larger or smaller as the distance from the eye. The drawing is therefore made in two projections, the same as though each part was seen from a point directly above. The same remark applies to all the views except that the sight is horizontal except in the plan. In perspective the drawing would be as the engine appears to the eye, and as the elevation in the previous number of INDUSTRY.

The two flywheels, it will be noticed, are shown only in one plane, but in section. These being cylindrical, a line through the center cuts all the sections, except the spokes, radially from the center, and as these sections are uniform all around the wheels no other view is required, except for the spokes, and as these are commonly made to known rules in respect to section and number, the side view may be omitted.

The scheme of the engine, as explained in connection with the elevation last month, is to quickly close the induction valves without releasing them from their connected gearing. The valves are opened positively by the main eccentric acting on short levers, the fulcra of which are suddenly shifted by a separate eccentric so as to close the valves at any point of the stroke, and as all movements are by means of links and motion rods, there is no limit to speed of revolution, as in the common Corliss releasing valve gearing. This can all be traced out in the drawing by anyone familiar with steam engines.

Messrs. W. T. Garratt & Co. have done well in providing frames, as shown in the drawings, because these engines are really of the high speed class.



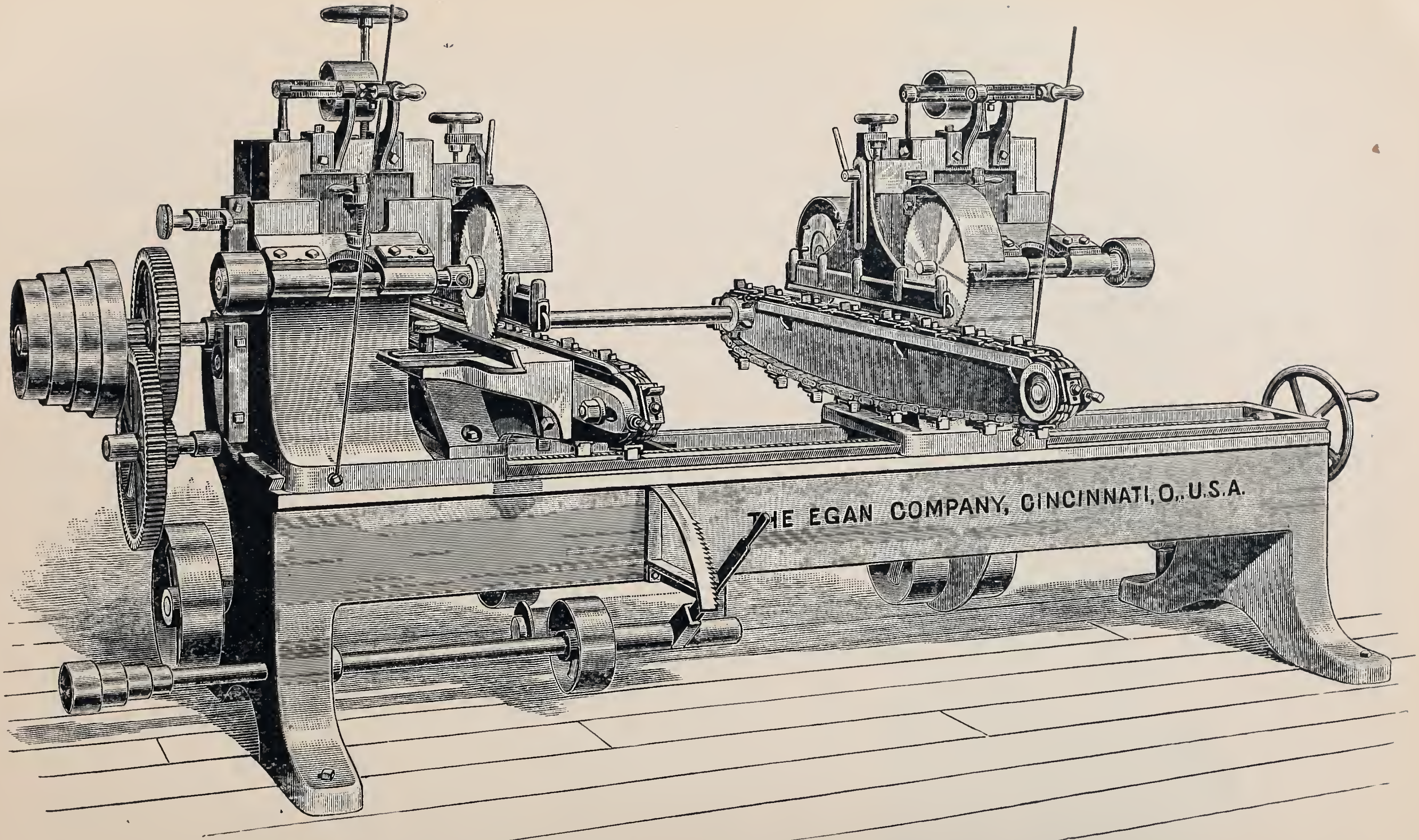
DIRECTLY GEARED HYDRAULIC DYNAMO.

THE PACIFIC IRON WORKS, SAN FRANCISCO.

The combination above shown, of a Dodd tangential water wheel and a Brush dynamo, is furnished by the Pacific Iron Works, and has the advantage over European modifications of these machines of being much more accessible and more simple in construction. The combination of Girard wheels and dynamos, or hydraulic dynamos as they were called, was early practiced in European countries, especially on the Continent, but the Girard wheels are by no means so completely adapted to the purpose as the California tangential ones, especially when a variation of power is necessary. In the Girard system the issues or inlets are rectangular, and the power varied by a slide which covers and uncovers the ports, like the slide valve of a steam engine, and as soon as a port is partially covered by the slide, the velocity and integrity, so to call it, of the jet is disturbed and the water lost.

In the plain round nozzle system in use here, there is not only a higher efficiency because of the circular form of the jets, but more complete control in respect to multiple nozzles to be "cut out," wholly or deflected; also, the important advantage of a first cost, not more than as one to two, and a more simple wheel in every way.

It is true there remain yet some problems in the regulation of speed that will, no doubt, be satisfactorily solved in time, and will perhaps be found in an "extraneous" or "brake" resistance on the wheels, equal to the percentage of variation.



Continuous Double-Tenoning Machine.—The Egan Co., Cincinnati, Ohio.

CONTINUOUS DOUBLE-TENONING MACHINE.

THE EGAN CO., CINCINNATI, OHIO.

Perhaps no other machine that can be referred to will so clearly indicate the wonderful advances made in the conversion of wood by machinery as the one shown on the page opposite.

It is quite within the memory of men now living when tenoning machines for joiner work came into use. We do not mean saws, but complete tenoning machines, with "dado" cutters for the shoulders, and helical or diagonal knives to work smoothly, transverse to the grain. Such machines were from the very first a complete success, not only in respect to performing twenty times as much work as could be done by hand, but doing it so much better that comparison was out of the question.

The coping heads, for "under-cutting," soon followed, and hand-made tenons were gone forever. The first machines formed a tenon on one end at a time, the length being gauged from one end, for the first tenon, and from the shoulder of that for the second tenon, but now not only is the stuff cut off square at each end to length, but both tenons are cut at the same time, so the shoulders are absolutely parallel, and the length between them uniform to the hundredth part of an inch. Even this would not do, however, for our time. The hand-moved carriage was too slow and too much labor, so a continuous feed is added, as shown in the drawing, the stuff moving forward by two pitch chains provided with stops, so there is a stream, so to call it, of material passing continuously through the machine.

The Egan Co., of Cincinnati, who send us the drawing, do not say anything of the machine's capacity; perhaps that is unnecessary, the inference being that a machine of the kind will prepare all the material that can be got to it, and away from it when finished.

It is scarcely within our province to criticise or remark upon the character of machines illustrated in drawings sent for publication, but in this case a word is due to the substantial, symmetrical and complete design of the one in question. Even the standards, or legs, have the "kinks" removed, and come down with a graceful curve to the floor, in the manner nature adopts in that most rigid of all structures—a tree. The company seem also to have discovered that some extra metal, to insure stability in machines of the kind, can be sold to sensible customers at twice its foundry price; a thing which makers of wood-working machines have been very slow to learn.

TIMBER-SAWING MACHINES.

BY S. W. WORSSAM, C. E., LONDON, ENGLAND.

The following article is sent by Samuel W. Worssam, of London, England, and will be found to contain a good deal of interest here, representing, as it does, practice in England, and Europe generally:

"In the conversion of large logs of timber—hard or soft—into flitches and boards, the tools generally used are the *circular saw*, the *frame saw*, the *horizontal reciprocating saw*, and the *band saw*. The first-named is in most universal use, by reason of its great producing power and the facility with which it can be manipulated, although at the same time the most costly, both as to waste of stuff and absorption of horse power.

CIRCULAR SAW.—For a log of 36 in. scantling, a saw of at least 78 inch diameter and 6 easy b. w. gauge is necessary, this means a wide kerf, with a corresponding waste of material. The cost of such a saw is £45, and the angular velocity 450 revolutions per minute, giving a speed at the periphery of 9,225 ft. per minute. Forty-five horse-power indicated is absorbed in driving a machine carrying so large a plate, and the average rate of cutting is 8 to 10 ft. per minute for hard wood and 18 ft. for soft.

The saw works in a rack bench, with traveling table running on rollers for the log and weighs 9 tons, the cost of the same, for logs 36 in. by 40 ft. long, when fixed ready for work being £325. It may not be out of place to remark here that, up to the present at least, it has not been found practicable to run saws of greater diameter than 78 in., although larger saws have been made. One was exhibited in 1862 of 87 in. diameter, 5 full b. w. gauge, and cost £60.

Occasionally for logs of greater dimensions than 3 ft. two circular saws are employed, one working above the other on separate spindles, but this arrangement is not recommended owing to the difficulty of getting the saws to run conjointly in a true plane.

FRAME SAW.—The second machine in the list—the frame saw—has the advantage of the circular when logs have to be sawn into boards, inasmuch as many and much thinner saws can be used simultaneously; thus, for converting a 36 in. log into 1 in. boards, thirty-four saws are requisite each of 13 b. w. gauge, whereby there is much less waste of wood as against the circular saw having 6 slack b. w. gauge. The number of strokes of such a frame carrying thirty four saws is 120, and the cost of the set with hook buckles, tillers and keys, £45. Such a machine weighs 12 tons, and the price for balks, 36 in. by 40 ft. long, fixed ready for working is £600. The average rate of feed, which is intermittent, for hard wood is 8 in. per minute, for soft 15 in. The blades are keyed in a swing frame, the tension on each being about 1 ton to every inch of width, a travelling rack or drag carriage running on rollers serves to carry the log.

On a comparison of these two modes of conversion it is clear that for boards the frame saw is more economical and productive, as a matter of fact, the circular should only be employed in ripping logs into flitches, which are subsequently re-sawn by the frame into thinner stuff or leaves.

Horizontal Reciprocating Saw.—The next reference is to the horizontal saw frame, which usually carries but one blade. The saw runs at a high speed and cuts inwards and outwards of the stroke, the guides of the swing frame being fixed obliquely in such manner that the saw teeth clear the cut at each half stroke. This saw, albeit somewhat slow in production, is, owing to its thinness, very saving in stuff, and especially serviceable for opening up costly woods, which have to be resawn when their character is ascertained. For balks 36 in. by 40 ft. long, the weight of the machine is eight tons, and the cost fixed for working, £400. The saw is 6 ft. 6 in. long by 6 in. wide, and 15 b. w. gauge, and makes 190 strokes per minute. The indicated horse power necessary for a machine of this character is 12 horse power. In hard wood the average rate of feed which is continuous, is 2 ft. per minute, in soft 4 ft.

A duplex horizontal saw frame has lately been patented for operating two saws independently of one another. These are strained in separate swing frames situated back and front of the main standards, driven from one crank shaft, and reciprocated alternately to be in equilibrium.

A vertical single-blade frame is now and then serviceable where limited motive power and ground space only are available, but it is rarely run at high speed on account of risk of vibration, increased production being attained by increase of stroke.

Band Saw.—To advert to the band saw—the last enumerated—is to trench on debatable ground and fish in troubled waters. This, although one of the most important innovations in the wood-working machine category, has given rise to greater controversy among manufacturers and users than any other. Few of these agree as to its merits and demerits as a means for the conversion of heavy work. In France and the United States its employment is universal, whilst in this country, where it originated, it has hitherto failed in finding favor. There may be many explanations for this, the difficulty with the saw itself, due to inferior quality and consequent breakages, the want of skill in the operative, and the impracticable design of the machine. Our sawyers apparently do not appreciate the fact that a band saw requires greater care in manipulation than either of the other types mentioned. The French and Americans, on the other hand, have given to it their most careful attention, and with satisfying results.

Unquestionably for heavy work, given a good saw, carefully designed machine, and skillful hands, the band saw is better adapted than any other, alike for the saving of horse power and economy of production apart from the fact that the travel of the saw being continuous it turns out superior work, which requires less subsequent dressing.

The highest quality of saws are manufactured by M. Perin, of Paris, who has made it his task to ensure that they shall withstand the necessary strain and tension they have to bear without fracture. He has likewise introduced simple modes of re-joining or brazing them when this does occur. Means have been devised to reduce the risk of snapping, which frequently arises from the too rapid cooling and contraction of the blade after ceasing to work. Modifications of the saw guides have been effected with a similar object.

In the States, webs of so great a width as 8 in. are in operation, but there is no gain in this, on the contrary, blades not exceeding 4 in. or 5 in. are found superior in not requiring so great tension and correspondingly heavy pulleys, and being liable to less friction in the kerf. The saw must be perfectly parallel in width and thickness, and of uniform temper and set throughout; the form, space, depth and set of teeth should be carefully studied. The gullet shape of tooth, *i. e.*, teeth with half round throats, is preferable for soft wood, and the hand saw for hard.

In practice it is found advisable to have small, loose, adjustable pulleys situated immediately above and below the stuff and bearing against the inner, flat face of the blade to obviate the necessity of straining it to a straight line between the points where it leaves the pulleys, whereby a lesser degree of tension and tautness is necessary. This is an important factor which has not been sufficiently recognized by designers and manufacturers. Any plan lessening the tension of the saw, minimises the chance of breakage, and lessens the otherwise requisite strength of the pulleys and standards of the machine.

Referring to the machine itself, this should be substantially and proportionally constructed with pulleys not less than 6 ft. diameter, the upper one being as light as consistent with strength, it having to be driven by the saw from the lower. The rims of the pulleys should be lagged with wood, or covered with leather or India rubber, to make an elastic cushion for the saw, although the writer has knowledge of a large machine, running for some years, the pulleys of which have no covering whatever, they are turned slightly convex, and the blade runs like a belt on riggers. The pulleys may have flanges, but these should serve only to prevent the attendant when mounting the saw from passing it at the back of them and damaging the finely-sharpened teeth. Should the blade unduly press against these flanges, or any fixed runner or guide, it will immediately buckle and swerve from the true line of cutting. Care must be paid to the design of the tension appliance to provide against the contraction and expansion of the saw whilst working.

With all these points strictly attended to, no reason can be adduced why this class of machines should not be as approvingly received at home as it is at present abroad.

In this country the prevailing type of band-saw machine is the vertical, which, for logs 3 ft. by 40 ft. long, costs, when fixed ready for working, £480, and weighs 10 tons. The saw pulleys are each 6 ft. in diameter, and make 300 revolutions per minute, giving a travel to the saw of 5,700 ft. This itself is 42 ft. long, 4 or 5 in. wide, 17 b. w. gauge, and costs £8 to £10; 20 horse power indicated is absorbed in operating it, and the rate of feed, which is continuous, in hard wood is 3 ft. per minute, and in soft 6 ft. The log is advanced to the saw on a table running on rollers.

In France these figures somewhat differ as there the machines are of less solidity, many of them having the traveling tables made partly of wood.

For logs $1^{m}00$ by $4^{m}00$ long, the cost of a machine fixed ready for work in Paris is 9,250 francs. The pulleys are $2^{m}00$ in diameter, having the rims coated with buff leather, and making 350 revolutions per minute. The saw is 10 centimèters wide and 14 dixiémes millimétre gauge. The indicated horse power absorbed is 20 horse power, and the rate of feed in hard wood $1^{m}00$ per minute, in soft $2^{m}00$.

For re-sawing flitches 24 in. deep by 6 in. thick, a double band saw machine is coming into vogue, in this case, the two saws run independently of each other, although the pulleys are on the same standard. To ensure uniform travel of the saws they are worked from one counter shaft only. One blade may be longer or shorter than the other, according to circumstances.

For flitches 24 in. deep and 6 in. thick, such a machine costs, when ready for working, £370, and weighs 6 tons. The diameter of each pulley is 4 ft., and makes 250 revolutions per minute, giving each saw a travel of some 4,375 ft. per minute. The initial length of each web is 32 ft., width 2¾ in., and 18 b. w. gauge, and costs £4. The indicated horse power consumed is 10, rate of speed in hard wood 4 ft., in soft 12 ft. The flitch is fed to the saws by adjustable vertical rollers.

Band-saw machines are designed and constructed to operate vertically and horizontally, but the former type is generally selected, and is that here treated of.

There are some other machines used in the conversion of balks, such as those for cutting veneers, etc., but these are omitted for the present as not coming strictly within the scope of this article.

THE MOTALA WORKS IN SWEDEN.

The great Motala engineering works in Sweden have failed. The circumstance affords a lesson in modern manufacturing economics. These works have been coddled by the Swedish Government in a very paternal way, and for ten years or more past have been "protected," in the common sense of that term, but they were wrongly founded and wrongly conducted. These works were in central Sweden at the apex, so to call it, of the Gotha canal, that crosses the country through several lakes and connects Stockholm and Gothenburg. They were originally founded as a portion of the canal plant for producing the metal parts of the sluices and other work, and were wholly inconvenient for many kinds of work undertaken there. Von Platen, the father of the great canal, and founder of the works, is buried there, on the bank of the canal.

The works sometimes employed 2,000 workmen, and produced $700,000 worth of machinery in a year. Dividing the money by the workmen shows a product for each of $350 a year, which is less than one third what would be done here, or in England. There was too much "science" at Motala, if that be possible. Marine engines were made there and carried by canal to the German Ocean and Baltic Sea, and made under circumstances that could not help resulting in loss.

Wages have doubled in Sweden during twenty years past, mainly by the influences of surrounding countries. In some industries this has made no difference, because "product" has also been doubled by new machines and processes, but these were not applicable to a sufficient extent in the works at Motala, and the end was a foregone conclusion.

The methods, of which we speak with some personal knowledge, were too much of the laboratory kind, and, as before remarked, there was too much science—too many learned men paid for what they knew, instead of what they could perform. Sweden has suffered a good deal in her industries from this kind of "high science."

THE FIRST COST OF SHIPS.

Mr. Charles H. Cramp, of the Company at Philadelphia, contributes to the *North American Review*, for January, an article under the above head.

It is a subject of which the general public are profoundly ignorant, if so strong a term will apply, and respecting which they will know but little more after reading the article in question. We mean will know but little more of the cost of ships, respecting which there is really no information given. One is led to think the writer must have forgotten the title so little is said that its terms apply to.

A practical man, or a business one, would naturally look for some facts respecting the cost of labor, material and expense of constructing ships. Some prices given for plates, angles, and beams, of brass, timber, paint, cordage, or the hundred other things that go to make up a modern vessel. The wages paid per ton for building, respecting which very elaborate statistics have recently been compiled in England, with which country he compares whenever comparison is made, are not mentioned at all. Implements, processes and methods are not reverted to, not even the elements that go to make up a ship, the proportions of these, and their cost in this and other countries.

A synopsis of the article would be that American ships, especially those made by his firm, are mysteriously superior to those made in other countries, and for the same amount of money he can furnish a ship of equal capacity with those made in England from material that costs about 75 per cent. less than it does in Philadelphia. This is, when dissected, an assumption of superior skill respecting which something more will be said further on.

We believe that a ship of the best class can be made here at very near the labor and implement cost that it can be in England. We further believe that methods, processes and implements here are likely to be faster improved than in England if ship building goes on to such an extent as to call out these resources, but how anyone is to build a ship at the same price out of material that costs nearly twice the price it does in England, and constitutes about 65 per cent. of the whole, is a problem that must be left to some one else to explain.

Present quotations for plates, angles and beams in New York is about 3 cents per pound, and in London is £6 to £7 per ton of 2,240 pounds, or less than 1½ cents a pound. There is not the same difference in other materials taken collectively, but there is certainly 50 per cent, so that taking the iron and steel as one half of the whole, the material account must approximate 75 per cent. advance on prices in England. Counting material as 66 per cent. of the whole, a ship made at the same cost for labor and expense would leave a margin of 49.50 per cent. to be made up in some way not very well explained in Mr. Cramp's essay.

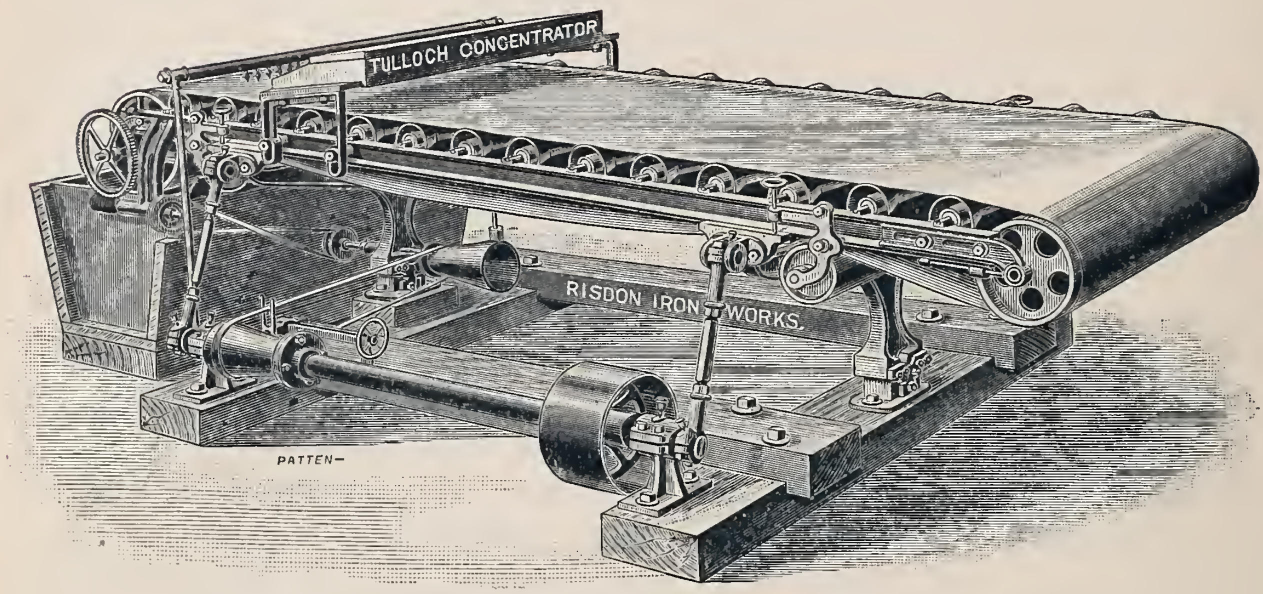
In respect to the quality of ships it is a matter very well understood by ship owners, and to those technically acquainted with the subject. There are none of the mysteries hinted at by Mr. Cramp, or at least none that need be much of a factor in determining the cost of ships. British, German and French practice is all displayed in the technical press of the various countries, so is the American in so far as war vessels, and allowing for a wide distinction in class in each country the practice is in all essential points uniform. It is true vessels of low class have not been made here, and are not likely to be so long as they are furnished only for American owners and not for the "trade," but to claim there is not an equal class made elsewhere is not a tenable position. The *Oceanic*, now in service out of this port, constructed 22 years ago by Harlan & Wolff at Belfast, is nearly as good a ship as when she was built, and in a recent prospective sale of the vessel the price demanded was not much different from her original cost. She is a first-class ship—as have been all of the great vessels made by the firm, which have cost a high price, and have paid to the builders, no doubt, a much larger profit than can be made here in similar contracts. It is useless to claim that anyone can build ships much superior to this.

As before remarked, Mr. Cramp's article when analyzed comes down to an assumption of superior skill, representing about a third of the value of a ship, and consisting in qualities that are in no way explained. Conceding this, and it is a ponderous concession, there arises another problem in the matter. The Union Iron Works, of this City, have bid successfully on a number of war steamers in competition with Messrs. Cramp, and at estimates not much different. Now the Union Iron Works pay about 20 per cent. more for their material delivered here, and from 33 to 50 per cent. higher daily rates for labor, which leads to the following proposition. That the Union Iron Works must apply much greater skill, lose a great deal of money, or else Messrs. Cramp must realize enormous profits on their work. The fact is that the mysterious skill hinted at by Mr. Cramp does not exist in his works or any other.

It is in the nature of things impossible that we can, in this Country, build ships to go out and compete in the world's traffic when 66 per cent. of the material in them costs double as much as in other countries. The wages problem need not be considered. The amount of wages paid will not vary much in shipyards only six days apart by sea, and we do Mr. Cramp the credit of believing he can, and does, construct ships at the same labor cost per ton that is paid in England or elsewhere on the same class of vessels. We also believe his expense account is not more. There is indeed indisputable evidence of both those things, in the fact, that the difference in the price of a first-class ship here and in England is not nearly as much as the difference in the cost of material alone, so that labor and expense can be no more here than there.

The appearance, at this time, of an article in the *North American Review* that will convey, as this one seems intended to do, an impression that it costs no more to build ships in this country than in England, cannot help proving a great impediment to an industry which the country is looking to with much interest. The true plan is to face the facts in their real aspect and merits, and then set to work to remove any hindrance to a successful competition. There is never anything gained in the end by methods that cover facts and quantities, capable of exact representation.

The true American who believes the skill and resources of his country equal to those of any other country, and is willing to stake his efforts on that proposition is the one who will build ships as cheaply as England, or elsewhere, under equal conditions, also hopes to build them cheaper under the inevitable advance that will come in implements and processes here as soon as there is room and encouragement for their use.



IMPROVED ORE CONCENTRATING MACHINE.

THE RISDON IRON WORKS, SAN FRANCISCO.

The machine shown above, designed by Mr. Andrew Fraser, of the Risdon Iron Works, and made by that company, is a marked departure from concentrators of its class.

It may be called an adaptation of the Tulloch machine in so far as its movements and main functions, but is widely different in construction. It will be noticed as a remarkable feature that a main frame is dispensed with altogether, and not with any sacrifice of stability or working properties, but on the contrary with a gain in both.

The apron frame, on which the main belt is sustained, is mounted on two rolling pivots on the foundation, and these being at some distance below the apron and the center of its oscillating or lateral motion, gives a movement corresponding to that of a batea. This movement of the apron and its frame is produced by the crank shaft in front, which is connected by two links to the side of the apron frame, as shown.

The crank shaft is also mounted on the foundation frame, and the crank connections being nearly vertical the thrust of the table's vibratory movement is thus changed to a vertical from a horizontal plane, and falls on the foundation instead of a surrounding frame as has been the custom in former practice. This is a very important matter, permitting the machines to stand anywhere without any sensible vibration. We have examined one running at a high speed on an upper floor, and could detect no sound or jar whatever from it.

The lineal or surface feed of the apron is made variable, in any degree, while the machine is in motion by means of the cone pulleys, shown in the drawing, one of these being placed at the center of the apron frame's vibratory movement, so that both pulleys are on fixed axes, and the tension of the band uniform. Another feature worthy of notice is in the provision of independent cocks for each jet where water is fed to the apron, so the amount at the sides, or in the center, can be varied at will.

We are informed that a number of these machines have been supplied, and have given great satisfaction. Patents have been applied for in this and foreign countries on these machine.

WATERS OF THE STATE AND NATION.

BY COL. RICHARD J. HINTON.

The following is the main, or local part of an able essay, reprinted from the *Irrigation Age*. The portion omitted for want of space, relates mainly to irrigation in Australia.

"A statement of the value of water for irrigation purposes present, and possibly may some time involve, questions far more significant than the actual cash embraced in their value. There is scarcely a center of American activity in irrigation under the control of a corporation or water-carrying company in which the right to permanently use a second foot of water could be purchased for less than $1000. This price will rise by a rapidly ascending scale up to the $40,000 per second foot, which has been paid in some of the fruit-raising counties of San Bernardino and San Diego.

Whatever may be the legal fiction indulged in as to the impossibility of selling water, it remains a fact that outside of the small ditches owned by farmers, and those controlled by Mormon influences, or in the new equities created by the California district system, that the conveyance of water, apart from the land which it is to serve, is practically a sale of the water conveyed. Some one has said that the American has no regard for yesterday and very little consideration for tomorrow. In all economic action this certainly seems to be a justifiable criticism. It is the good fortune of the irrigation situation, in view of the great results that are to flow from such development of industry and enterprise, that there really is some time given to consider the best methods of avoiding future complications, and to endeavor to realize the manner in which the least friction and the largest results may be achieved. Facing the discussion of the ownership and management of so vast an estate by seventeen or more different commonwealths as that involved in the transfer of our present public domain, it is as well for those directly interested as it is for the country at large to consider the salient problems and larger aspects that are embraced.

SOME TROUBLESOME QUESTIONS.

Foremost among these is the relationship of international and interstate waters. There are questions involved that cannot be pushed aside by a wave of the hand, or a declaration that they will be taken care of as they arise. Even if such a policy could succeed it would be unwise because involving too great cost and too much friction. It is not necessary to establish a cut and dried plan of water management in advance of the necessity for action, but it is desirable to understand the conditions, and endeavor to realize the fundamental equities that are involved in them. If the arid regions of the United States were to-day without occupants, and if the general Government possessed the power and authority of paternal autocracy, an ironclad policy like that proposed in withdrawing land from settlement, in demanding a topographical survey before occupation, or in establishing, for civil as well as irrigation purposes, self-governing hydrographic basins, unrestricted by political geography and bounded only by mountain or other lines from which the water supply could be obtained, might be realized. But there are settlers, there are states, vast interests have already been created, irrigation has obtained a large headway. It is only the theorist who ignores facts. It is only the autocrat scientist who derides them.

Nine states have embodied in constitution and law the jurisprudential principle that the natural waters, such as streams and lakes, are the property of the State to be distributed only under legislation for beneficial purposes. Four other commonwealths, west of the 97th meridian, have legislated in stringent fashion in the same direction, three of the four territories interested have, by law, recognized that the natural waters of the territory above ground are the property of the people, the use of which is to be regulated by the community under general law. This legal status is a starting point of a very notable character in the direction I propose to consider. It involves also the possibilities of conflict over such water supply, and it emphasizes very strongly the necessity of preparing in advance of possible conflict for a legal adjustment and administration of the issues and interests which may arise. These are questions which are sure to come up upon the floor of Congress, pending the discussion and settlement of the policies so broadly outlined by the states directly interested in irrigation. It is easy to perceive that if each of the states interested are in their organic capacity each alone and solely sovereign in their control of all waters that rise within their borders and yet flow largely beyond them, that many interesting complications must inevitably result from a rigidly, independent enforcement of such sovereign rights. Let me illustrate what I mean by reference to both the international and interstate waters, the management and disposition of which may easily give rise to disputes and litigation of a serious character. Under some circumstances even such conflicts might take a more serious form.

MEXICO AND THE BRITISH COLONIES.

The United States has for neighbors, in the southwest the Republic of Mexico, and on its northern frontier the British colonies. Most persons would deride at the first statement, the possibility of a serious dispute between portions of the New Dominion and portions of the United States over water supplies. Yet if we follow the frontier from Pembino to Puget Sound we shall find important sources of water supply that rise on the British side of the line, and flow within the United States. It is true that they serve a much larger territory there than in the region in which they rise. I name the Milk, the Souris or Mouse River, and the sources of the Columbia—such as the Kootenay and Okanagan Rivers, and lakes in British Columbia—as water sources, whose value is likely to prove so great to both countries as to necessitate the adjustment of the equities involved. Applying the state sovereignty idea of water control, the New Dominion authorities would have the right, if it be possible, to prevent, by all artificial means within their power, the flow of these and other streams from their own to the territory of the United States. This is a possible if not a probable contingency. Irrigation jurisprudence, as it is now being evolved, must take some cognizance of such facts. The international question, however, is more serious and more pressing too, so far as it relates to our southwestern neighbor—Mexico. The Rio Grande, for example, is the frontier line for over 500 miles between the two Republics.

It rises in Colorado, is the chief source of supply for about one-fifth of that great state, before passing southward and bisecting New Mexico for nearly 400 miles. According to the fundamental law of Colorado, all of the sources of the Rio Grande and all other supply therefore, which fall within the state borders may not only be properly utilized within Colorado, but any surplus that would naturally flow southward could lawfully be prevented from doing so if engineering skill can provide the means to accomplish such a result. The ruin of the communities below would not necessarily be within the legal purview of the situation, nor could the state take any action of itself to settle the international complications that would surely, nay, have already arisen. The United States alone can do this, yet it has no legal power over the waters of the Rio Grande so far as that stream rises and flows within the borders of Colorado. It has only a greater power and duty, that of preserving the national safety and honor. The Rio Grande is not the only stream, however, by the flow or diversion of which our relation with Mexico might be seriously affected. The Colorado River, in the extreme southwest, has its rise far to the north and east in Wyoming and Colorado. Both declare their sovereign ownership and right of control over waters rising within their borders. The Colorado, when formed by the junction of the Wind and Green Rivers, flows through Utah and Arizona receiving, among others, the Gunnison, the Grand, the San Jaun, and most of the drainage of northern Arizona. Also, the Salt and Gila Rivers in the south and center of that territory, it then flows through the lower corner of California and Arizona, into Mexican territory and the Gulf of California. It is almost as great a silt bearer, according to its volume, as the Mississippi River. The shoaling of the gulf head is continuously going on. The enormous fecundity of the lower Colorado Valley and of a large portion of the alleged desert areas adjacent thereto, if water can be permanently supplied and distributed over their lands, is already attracting the attention of capital. The possibility of diverting the Colorado waters above the cañon region, and of making available large areas of dry land, whose fertility and climate will assure, with water, the production of the finest of semi-tropical products and fruits, is one certain to be considered at an early day. International, as well as interstate, questions must therefore arise in the management of water supplies taken from the Colorado River. These cannot long be ignored. In my judgment they will rise more rapidly and demand solution more speedily, should the comprehensive policy, sustained by the Utah Irrigation Congress, became an established fact through favorable legislation at the capital. The international questions that are likely to arise cannot, of course, be taken from the control of the general Government, however complex and difficult their settlement may be made by questions of state jurisdiction over streams that are international in character.

THE INTERSTATE WATERS.

The problems involved in the interstate management of natural waters require to be more immediately considered. They are sure to be the first taken up in debate by Congress, and I suggest also that a majority of the commonwealths within the lines of aridity are, on the face of the thing, interested against the minority thereof. Let me illustrate what I mean :

Two great mountain lines control the climate and topography of the whole region, of these the Rocky Mountains is the foremost, not only in position, but in magnitude. That area is almost entirely divided between three commonwealths—Colorado, Wyoming and Montana. That portion of the great range which shapes and dominates the Territory of New Mexico is, so far as the water supply question is concerned, entirely subordinated to the area north of it.

The Colorado plateau region, uniting on the south the Rockies and the Sierra Nevada, is not significant as a source of water supply. Let us examine a map of the United States. From the southern line of Colorado to the British line in Montana on the east, it will be seen that all the headwaters of the Missouri system and of great tributaries of the Mississippi are located within the lines of the three states named. Colorado has the Arkansas and the Platte, and is the gathering ground also, in its eastern section, for the Republican and Smoky Hill sources of the Kansas River. On the east, Wyoming contains within its borders the North Platte and its branches, the Niobra and the Yellowstone. It is true, of course, that by the reservation of the National Park, being located within the boundaries of Wyoming, that the headwaters of the Yellowstone are separated from actual state control. Passing north into Montana the upper Mississippi and all its tributaries find their sources within the boundaries of that state. Crossing to the west side of the Rockies, what do we find? Beginning at the north, the American headwaters of the Columbia River are all found within the boundaries of Montana with the exception of its largest tributary, the Snake River, which finds its source of supply upon the western flanks of the Rockies, within the bounds of Wyoming and southeastern Idaho. When these great hydrographic systems have been named, nearly seven tenths of all the natural waters found west of the 97th meridian are seen to receive their supplies from the Rocky Mountain drainage, and to have their sources within the boundaries of three out of the thirteen states now in existance, and directly interested in the problems of irrigation. On the eastern front of this remarkable region the States of North and South Dakota, Nebraska and Kansas, with the Territories of Oklahama and New Mexico, are directly involved and related to the water supply rising within these three mountain states. I am not stating or implying that the people of Colorado, Wyoming or Montana, in either their individual or state capacities will seek to interfere with the natural distribution of the waters that rise in their midst, but the primary necessities of irrigation will compel, ere long, the consideration of engineering means, and the economic needs of diversion and distribution that must seriously affect the nature of the natural flow and volume of water that the channels of streams would normally carry. These problems and necessities must arise and will be met, indeed they have already arisen. The people of Mexico declare that the diversion of the Rio Grande in Colorado has, in great part, destroyed the prosperity of important communities in Chihuahua. The people of New Mexico have already begun to grumble. Those of Kansas and Nebraska are in dread. The Dakotas are not yet alarmed, because their present settlement problems are embraced in the development of artesian and underground waters, but their turn will come. On the west side of the Rocky Mountains, Idaho, Nevada, the eastern portions of Oregon and Washington, western Colorado, Utah and Arizona, are all directly interested in the water supply whose sources rise in the three states named. The Columbia, the Snake, the Wind, the Green, the Grand, the Gunnison and the Colorado Rivers form hydrographic basins whose water sources are under the sovereign control of the three states created out of the Rocky Mountain area.

The remaining interstate waters are few in number, the Bear lake and river, rising in southeastern Idaho, forms a hydrographic basin whose outlet is the Great Salt Lake in Utah. In northern Nevada there are several mountain streams tributary to the Snake River, such as the Bruneau, the Quinn and the Owyhee. It is not probable that any serious questions would arise from the disposition of these streams, as the whole of their drainage and flow however important to Nevada would not greatly affect the volume of the Snake River. Further west, Oregon and California have in common an important hydrographic interstate basin. This is the Klamath river and lakes. Going southward, Lake Tahoe, the whole of which is in the natural basin of Nevada, but only one third of its area within its political boundary is the only important body of interstate water to be found. As it is navigable in character, the United States may probably and properly claim some rights of control as to its utilization in other directions. Even now its value is so great that serious interests are involved. San Francisco demands its utilization in the near future as a source of domestic water supply. The outlet into the Truckee basin at Tahoe City is under the control of the capitalists who have, I believe, expressed their wish to dispose of the same to gentlemen like Mr. Newlands, personally and patriotically interested in the reclamation of Nevada. It is hardly to be supposed, however, that the State of California will permit the control of this great storage basin to pass on a mere commercial basis to the State of Nevada, which can legally claim only one third of its great area."

THE STATE MINING CONVENTION.

The State mining convention held in this City on the 21st and 22d of last month, was largely attended, and characterized by a desire to arrive at some amicable settlement of various problems connected with hydraulic mining. The gist of the proceedings can be summed up as follows:

The farmers are willing that hydraulic mining should go on, provided their lands or interests are not injured.

The mine owners are anxious to resume hydraulic mining, but do not want to injure lands or water ways.

Legislation on this matter has been too drastic in character, and can be improved.

The general government should assist in building works to impound the debris from mines.

Of methods, but little was said, and as this will form the first subject of inquiry in case an appropriation from Congress is asked for, the convention should have prepared itself with some practical views on this branch of the subject.

The report of the government commission on the practicability of impounding mining debris, mentioned in the proceedings, should be published in connection with them, especially as the report has not, so far as we know, been given out in a public way.

Impounding debris, or "slickens," is very much like impounding water. The height and cost of dams and dykes are inversely as the area impounded, and the volume retained, or confined, is almost directly as its area. This, if conceded, will mean that retaining works in the mountain valleys and cañons will cost a great deal of money. If the slickens can be directed into the Yolo basin, and other low lands in the Sacramento valley, and currents destroyed by dykes so the silt will settle, the result would be making land instead of destroying it. It is purely an engineering problem. The equities are easily arrived at.

ELECTRIC RECIPROCATING MACHINES.

Mr. Charles I. Van Depeole has, in an exhaustive way, investigated the application of electricity to producing reciprocating movement in machines, and discusses the problem in respect to rock drilling, steam hammers, pile drivers, and even rotating engines, in which reciprocal movement is connected to rotative, by means of cranks.

Mr. Van Depeole, after discussing technically the various applications above named, and the principle or mode of operating, winds up his essay in the following words:

"The foregoing clearly shows the application of the electric engine to the different branches of transmission of power. It will be seen that there is no end to the application of the same to the performance of all kinds of work that is now being done with more or less success by other means of transmission.

"The only question now left regarding the application of electricity, or other power to the different branches of mining and other industries, is the difference in expense of the first cost of the plant and the cost of operating the same, so that it becomes the duty of the engineer charged with the installation of such or other plant, to see which of the many systems available to him will be the most economical in practical use. There is no question, however, but that electricity goes ahead of any and all systems of transmission, inasmuch as it is the only agent which will allow of great division of power from a central place with the greatest amount of efficiency as compared to any of the other known agents in use up to the present date."

It would be presumption for any one not an electrician to question so eminent an authority as Mr. Van Depeole, but the chances are that the economical propositions involved in the quoted paragraph will meet with a good deal of criticism, especially in the claims for efficiency in the last clause.

The action of reciprocating machines is much varied, owing to the distance through which effective work is to be done. A rock drilling machine and a pile driver, two of the examples named, will serve to illustrate the difference. In the case of a drill, which can act throughout only a very short distance, not more than one sixteenth of an inch, requires a quick, sharp blow, and calls for frequency, or high speed, while in pile driving, where the work is, in a sense, "pushing," or ought to be, the effect is to be measured more by mass and intensity than by frequency and speed. The inertia of the pile being a qualifying factor that does not apply to rock drilling and most other "hammering" operations.

The same difference exists between light and heavy forging, and in such degree that good adaptation must involve control over the weight of the respective mass. This, as we understand it, is not the case with electrical apparatus, and calls for a distinction that is omitted in the essay referred to. There is also the question of why a paper of this kind has not dealt with such dynamic conditions, and why it has not been presented through the medium of some of the technical associations, where a free discussion would have thrown much additional light on the subject.

The hindrances thrown in the path of progress by untenable claims for new inventions is a fact of our day that should be kept continually in view. There is much doubt that reciprocating movements will be produced by electrical apparatus, to the extent indicated by Mr. Van Depeole, and when some more successful progress has been made will be time enough to generalize on the subject.

THE BATTLE-SHIP OREGON.

On the 14th of January, Mr. Irving M. Scott, of the Union Iron Works, conducted a party of twenty or more people, on the tug *Active*, to witness the ceremony of driving the first rivet in the battle ship *Oregon*. General Ruger, of the Army, and Admiral Irwin, of the Navy, with their staffs and invited guests, came in their vessels, the *McPherson* and *Ivy*, making up a party of a hundred or more, that were much interested and pleased at the ceremony of driving the first rivet in the keel plate of the new vessel. This was done by the General and the Admiral, in a successful manner, and the remainder of the time, several hours, was devoted to looking through the works.

The great tugboat *Fearless*, of 1000 horse power, now nearly done; the *Monterey*, coast defense vessel, also nearing completion. *Cruiser No. 6*, well advanced. The keel laid for a new Pacific Mail ship of the first class. A Government light ship, well advanced, and two vessels on the dock for repairs, make up a list that shows the extent to which the Union Iron Works has developed a shipyard of the first class.

The work on both machinery and hulls is facilitated in various ways by ingenious appliances peculiar to the works, among these may be named the overhead cranes in the ship yard for handling plates, beams and other parts that are conveyed by power, and in a measure adjusted to position by the machinery which traverses and spans the whole vessel, while she is on the stocks. Such advantages, with something in climate, have to make up for a difference of eight cents a pound on material, and a third more in the rate of wages, that the Union Iron Works have to contend with compared to Eastern yards, who bid on the same vessels.

The tugboat *Fearless*, one of the largest ever built in this country, is a second one for Messrs Spreckles, of this City. The first one, the *Active*, on which the party was conducted, is, after six years of service, in perfect order and in design is as nearly perfect for the service as such a boat can be made. Whatever the resources of this Coast will permit in iron ship building, Mr. Scott and his able staff will work out, and among our various industries it will be hard to point out another that has been characterized by such indomitable energy and success.

TECHNICAL SOCIETY OF THE PACIFIC COAST.

SAN FRANCISCO, CALIFORNIA.

INSTITUTED APRIL, 1884.

TRANSACTIONS.

(VOLUME VIII. NO. 3.)

ONYX ON THE PACIFIC COAST.

BY PROFESSOR LOUIS FALKENAU, MEM. TECH. SOC.

[Read Sept. 4, 1891.]

The demand for material adapted to the interior decoration of buildings is steadily increasing, and for some time past variegated marble and the so-called onyx have been extensively used, as they are more easily cut and polished than other stones, and are otherwise preferable to many of the materials at our disposal.

Onyx proper is a species of quartz of great hardness, and occurs in small fragments, or nodules, while the so-called onyx of which this paper treats is mainly calcium carbonate, mostly in the modification called aragonite, and occurs in large masses. Its hardness is from 3½ to 4, its specific gravity from 2½ to 4, and it is easily cut into slabs and polished.

Onyx has been found in several localities of our State, but with a few exceptions, in small deposits, that do not yield large and perfect slabs. Large deposits have been found in Arizona, and new finds are constantly reported from all parts of the United States. Mexico has many fine deposits of onyx, most of which is used for clocks, table tops and small ornaments. The specimens of Mexican onyx, which I have here, are from La Sorpresa and La Mesa Mines, Tehuacan Pueblo, of which I have received the following description by the owners:

The deposits of onyx are found running through hills measuring about four miles across, at an angle of about 45 degrees, in layers of from 4 to 15 inches in thickness, separated from each other by parallel layers of clay, gravel and country rock. The deposits reappear on the other side of the cañon, running into the opposite hills at about the same angle.

The Sorpresa onyx is mostly white and green. The La Mesa, variegated. The first is near the bottom of the hills, the latter above it; a hard, red country rock separates the two mines. No marble, and no calcite crystals have thus far been found there. The deposits have been worked for three or four years without the use of machinery. From 5,000 to 6,000 cubic feet of onyx have been shipped to Paris, London and New York at a price of about $10 per cubic foot. The shipping port is Vera Cruz, which is reached in one day by railroad.

As the croppings of these deposits have been traced for five miles along the hillsides, and extend from the bottom of the hill to the top, the amount of available material is very great. The largest slabs obtained were 12 feet long, 8 feet wide and 5 feet in thickness.

In our State the deposits of Suisun, and of San Luis Obispo, have for several years past been worked by Messrs. J. & F. Kesseler, of this City, who have kindly furnished me these specimens and the following description of the San Luis Obispo quarry:

To Prof. Louis Falkenau.—Sir: According to promise, we send you a short statement regarding our onyx mine in San Luis Obispo County, Cal. The mine is situated about thirty miles from San Luis Obispo, and about twenty miles from Pismo Beach. It lays in the hills between Huasno Creek and Arroyo Creek, about sixteen miles from Arroyo Grande, a station of the narrow gauge railroad. The ledge stands nearly perpendicular on the side of a hill. The earth and stone in front of the ledge have been removed to the depth of about forty or fifty feet for a distance of eighty feet along the ledge, which is sixteen feet wide on the top and gets thicker going down.

The croppings show themselves from three to four hundred feet along the ledge, and again about half a mile to the northwest. The blocks stand all on their edges, and are from two to three feet, from eight to twelve feet, and some from fifteen to twenty feet long, and from six inches to eighteen inches thick.

Along the ledge there are also several valuable mineral springs. The onyx has beautiful colors—red, green, sky-blue, rose color, and a lovely golden yellow. The rich colors run in charming and graceful transition from one shade to another. Men who have worked and used onyx extensively declare it to be the finest onyx known. It has solidity, large sizes, beautiful colors, and an endless variety of tints. It is within easy reach of San Francisco, whence it may be shipped to all parts of the world.

Surrounding the mines and springs are nine hundred and twenty-nine acres of land, which form part of the property; they have plenty of timber and running water, and would form a beautiful park for the springs. Very respectfully,

San Francisco, March, 1891. J. & F. KESSELER.

I have no knowledge of other deposits in California having been worked to any extent. The Arizona deposits, discovered in August, 1889, which I visited in September, 1890, are located in Yavapai County, about 28 miles southwest from Prescott. The onyx is found in a group of low rolling hills. Eleven claims of 600 × 1,500 feet cover the location. The bottom of the hills, and the beds of the creeks and gulches surrounding them show strata of conglomerate, formed of fragments of onyx mixed with other rock and cemented by lime carbonate. Above these the onyx crops out boldly in well-defined strata of from 12 to 20 feet in height, extending into the hills almost horizontally, with a slight dip toward the center.

The tops of the hills show indications of onyx, and several shafts sunk at a considerable distance from the hillsides show solid masses of onyx immediately below the surface. At the time of my visit, only about 1,800 square feet of the ground had been explored by cuts and shafts. At a very conservative estimate, I would say that there were 1,440,000 cubic feet, equal to 144,000 tons of onyx then available. Should, as is very probable, the balance of the still undeveloped croppings, prove to represent strata of equal dimensions to those already opened, the available supply would be practically inexhaustible. Large blocks, some 7 × 4 feet and 18 inches in thickness, had been separated from the mass by blasting, and from such blocks most of the samples I have here were broken by a sledge hammer. That the material stood such treatment as well as it did speaks highly for it.

The many varieties found in this deposit differ very much in color and density (8 to 10 cubit feet per ton.) Analysis showed the presence of iron, manganese, strontia and magnesia, and it is to the iron and manganese the different tints are due.

Several tons of the onyx were taken to Colton to be cut and polished. The small slabs I have here are samples I brought from there.

Lately a new location has been found near Phœnix, Arizona, which is said to produce onyx of good quality and in great abundance. The cost of onyx varies from $5 to $10 per cubic foot, and over. To what extent it is used may be inferred from the following amounts expended on it: In Vanderbilt's residence, Newport,

$250,000; C. P. Huntington's residence, New York, $100,000; Equitable Building, New York, $75,000; Auditorium Hotel, Chicago, $60,000; Imperial Hotel, New York, $500,000; Grand Union Hotel, New York, $25,000.

At the time the foregoing paper was read there were exhibited about forty specimens of onyx having polished surfaces and presenting almost every shade of color, and showing the laminations which indicated the manner of its formation by desposition.

REGULAR MEETING, JANUARY 7th, 1892.

PROCEEDINGS.

MINUTES.

Held in the main hall of the Academy of Sciences, and called to order by the President at 8:30 P. M.

The reading of the minutes of the last regular meeting was ordered to be dispensed with.

The following new members, having been balloted for, were declared elected:

Professor F. G. Hesse	University of California.
Wm. C. Alberger, civil engineer	San Francisco.
R. B. Elder, electrician	"
Chas. A. C. Duisenberg, merchant, Associate	"

The following names were proposed for membership and referred to the Board of Directors:

For members:

Frank H. Olmsted, civil engineer, of Riverside, Cal., proposed by Burr Bassell, P. J. Flynn and Otto von Geldern.

L. C. Russel, mechanical engineer, San Francisco; proposed by C. A. Stetefeldt, F. Orton and John Richards.

Theodore Wetzel, Jr., mining superintendent, North Bloomfield, Cal.; proposed by A. d'Erlach, Geo. F. Schild and Otto von Geldern.

For juniors:

Geo. P. Cramer, surveyor, Seattle, Wash.; proposed by J. P. F. Kuhlmann, Luther Wagoner and Hubert Vischer.

J. F. Morrow, surveyor, San Francisco; proposed by Hurbert Vischer, Luther Wagoner and Otto von Geldern.

The Nominating Committee made the following report, proposing names for officers and directors of the Society for the ensuing year:

San Francisco, January 4th, 1892.

To the Members of the Technical Society of the Pacific Coast:

Gentlemen: Your Nominating Committee, selected to propose the names of candidates for election of officers and directors of the Society for the year 1892, herewith submits a report, and begs to propose the names of the following gentlemen:

President, John Richards. Vice-President, Luther Wagoner.
Treasurer, Geo. F. Schild. Secretary, Otto von Geldern.

DIRECTORS:

W. R. Eckart. C. E. Grunsky. H. C. Behr.
Geo. W. Dickie. A. Schierholz.

Your committee calls attention to the efficient management of the Society, and the progress made during the past year, and rejoices in having succeeded in so great a measure in inducing the same members to express their willingness to serve during the coming year.

Respectfully submitted,

L. J. Le Conte,
Geo. F. Allardt,
Hubert Vischer,
J. C. Sala,
F. Gottfried.
Nominating Committee.

The President then introduced Mr. Geo. W. Dickie to the audience, who proceeded to address the Society on the "Ocean Commerce of San Francisco," which was thereupon publicly discussed by those present.

(This interesting subject and discussion will be published in a subsequent bulletin.)

Adjourned.

Otto von Geldern, *Secretary.*

ANNUAL MEETING, JANUARY 15th, 1892.

PROCEEDINGS.

MINUTES.

The annual meeting of the Society was held on Jan. 15, at the Society's rooms, in the Academy of Sciences Building.

The Ballots for officers for the current year were counted and the following officers were elected.

President, John Richards. Vice-President, Luther Wagoner.
Secretary, Otto von Geldern. Treasurer, Geo. F. Schild.

DIRECTORS:

W. R. Eckart. C. E. Grunsky. H. C. Behr.
Geo. W. Dickie. A. Schierholz.

After the ballot for officers had been declared the President presented and read the following address.

ANNUAL ADDRESS.

BY THE PRESIDENT, MR. JOHN RICHARDS.

(Read January 15th, 1892.)

In pursuance of a custom that is common in associations of this kind, and one that has much to recommend it, I will venture to occupy some of your time this evening with a kind of review of the various circumstances of the past year attending on our own Society, and the objects to which its energies are directed.

My first duty will be to acknowledge the honor conferred by the selection as your presiding officer for a third time. It has been a matter of circumstances rather than because of any claim or qualification on my part, and is, for that reason, the more to be esteemed. It is unsafe to make promises for the future. For the present I can speak, and will say there is a stock of good resolutions covering such duties as I can perform.

The directors and their committees form the active governing element of the Society, shaping its policy and conducting its affairs, and for the coming year we will have in this capacity able and experienced members, who have consented to serve, in some cases, at a good deal of inconvenience to themselves.

During the past year some change has been made in the constitution and by-laws of the Society, not of a material kind, but relating mainly to procedure and the qualifications for membership. These changes are not of sufficient importance to require attention or comment at this time.

The reports of the Secretary and Treasurer show the condition of the Society, in respect to membership and finances, also show, or will call to mind the changes made in our environment, to so call it.

A good deal of money has been demanded, and a good deal spent, but, in all cases, with care and discretion. The present hall and its fittings, in which we have a proprietory interest; the very complete club room and connected offices, have been furnished and arranged during the past year, and, it is believed, will serve the requirements of the Society for many years to come, with only the expense of maintenance.

An important advantage during the past year has resulted from the Secretary's business permitting his presence here nearly all the time during business hours, and, I may add, also in a very efficient discharge of the duties pertaining to that office, which is really the main executive one in associations like this.

Turning now to retrospect, the Technical Society of the Pacific Coast has not been evolved from a small beginning and a few members, as is common in such cases, but it has, nevertheless, been obliged to follow the inexorable law of evolution, of which the main element is time. The Society was founded in 1884, and the roll signed at the time of organization, contained the names of 61 civil engineers; 30 mechanical engineers; 12 mining engineers; 11 architects; 6 chemists, and two patent attorneys; in all, 126 members. This was an extraordinary beginning, not only in respect to the number of charter members, but also in the character and qualifications of those enrolled. It included most of the eminent engineers in the City, and as an assemblage of people engaged in technical pursuits, could not, perhaps, have been excelled among an equal population in any other part of the United States.

As a result of this, the first papers presented and read before the Society were remarkable. They speak for themselves, and I will digress here to say that the value of these papers was reciprocal, and their influence much wider than is commonly supposed.

A look through them recently, discloses the fact that, in most cases, the papers presented have aided and greatly promoted the interests of those who contributed them. The members who prepared these essays have become distinguished in the branches to which their papers related, perhaps they were so before, in most cases, but there is a fair inference that the time and pains invested in the work have been well returned.

It is to be hoped our new members will make a note of this. It is a road to professional success, and the better the paper the greater the success. It is seldom that anyone engaged in any technical calling prepares an essay on a set subject without an adequate gain in some way. The gain may not come at once, or soon, but it will arrive some time and remain.

Returning to the Society, the selection of a title was fortunate and appropriate, adopted, no doubt, because the membership was to be drawn from not more than one-fortieth part of the population of the whole country, and, consequently, under circumstances that precluded a division of professions and pursuits, such as can exist in the Eastern States, and in the populous countries of Europe. This scheme has proved a most fortunate one, because there is, perhaps, no other association of the kind that has worked more harmoniously and been more free from all kinds of dissensions, such as might have been apprehended, and is too common in associations of the kind.

The Society's history, for several years, was nearly what inference would assign. The ablest members presented able papers on the subjects with which they were most familiar, and then came a season of apathy. There was no effort to connect the Society's work with the active industries and interests of community. It was a purely scientific association, such as this bustling utilitarian country is not yet ready for, and will not be for a long time to come. We can cultivate and promote scientific research in this country, and do so to a great extent, but not in the abstract, as it is done in Europe. There the commonwealth is the great fact of a country, here it is the person, and his business. Here everything to succeed must be connected in some way with the active affairs of life, and involve a factor of dollars and cents.

It is trusted that this is not an unfair criticism, or at least that it is true criticism. The purpose of its introduction here is to urge again upon the Society and its new board of directors the expediency of forming a permanent committee on arts and sciences, with the power of examining and reporting on new and useful inventions and discoveries, also on meritorious papers, and recommending the award by the Society of some kind of certificate or diploma, that will have a commercial as well as a scientific value to those who submit subjects.

There are objections to such a committee and procedure, but pitted against such objections are the facts that have just been reverted to, and our first duty is to make the Technical Society permanent and useful. In case unworthy subjects were submitted to such a committee, it is easy to ask the withdrawal of them without action. The Franklin Institute, of Philadelphia, has for many years — twenty, or more — maintained a committee of this kind, and the secretary of that institution will, no doubt, be glad to furnish information respecting the working and results of the "committee on arts and sciences," and the awards given in case of meritorious inventions. The adoption of a similar method here would require a good deal of consideration, and it might be some years before it would reach a practical working character. It is, however, worthy of serious consideration.

It would be agreeable to occupy a good deal of time in discussing this matter, but it is so eminently suited for general debate that I trust some of the members will, at an early day, present an essay on the subject, and thus arrive at a concensus of opinion respecting it.

In connection with this matter of a permanent committee on arts and sciences, or on new and meritorious improvements, which would be a better name, there is another matter that has engaged the attention of some of our members, and which can be recommended to the new board of directors for their consideration. I allude to lectures of a popular kind, in addition to set papers. By popular, is meant lectures technical in nature but popular in character, such as can be prepared or delivered without the research, computations and drawings, that are commonly required in our regular papers.

Such lectures, we have reason to believe, would be gladly contributed by members and others, if invited, and, in this manner, the Society would not only be brought into closer contact with the community and its interests, but it would relieve the membership from what is a severe tax on their resources.

It may seem an easy matter among a membership exceeding two hundred to secure monthly papers of a technical kind, such as should be published in the Society's bulletins, but it is not at all an easy matter. Such papers are expensive to prepare, and expensive to publish, and, under the present method, too many in number.

The American Society of Mechanical Engineers has a membership of 1,300, and holds two meetings each year. On the same basis that we attempt, this Society would produce seventy-two set papers each year, which, I need not say, is far in excess of the number presented.

In respect to the field in which the energy and influences of the Society are to operate, or to which its efforts are particularly directed, it will not be too much to claim that it is peculiar, or even anomalous. On this Coast the extent of engineering and technical work, in proportion to the population, is not only vastly more than in other communities of like extent, but is varied in a degree that has no parallel in any country.

These peculiar circumstances arise not only from a diversity that embraces nearly all the industries of our time, but to peculiarities of methods and requirements that arise out of climatic and other physical conditions peculiar to the Pacific Coast. I will mention only one, for illustration, the harvesting of wheat. This operation, which in most countries is no more than a farmers' problem, supplemented by ordinary maunfacturing skill, becomes here, in California, an engineering one, involving peculiar machinery, immensely greater in size and power than is employed elsewhere, also with very different functions. The wheat is cut, threshed, and put into sacks at one operation, and by one machine, requiring as many as twenty-four horses, or equivalent steam power, to propel it. From 1,000 to 1,500 bushels are thus cut, cleaned and put into sacks in a day, by one machine, requiring, at most, the labor of five men, and is done, by contract, at a cost of not more than a cent a bushel. This is one fifth as much as the same operation costs in the Eastern States, and is only a tenth as much as in India, where the rate of wages is one fifteenth as much as in California.

Ten years ago the steam engines brought here for threshing failed to meet the requirements, and the manufacture was commenced in a number of different works in this State. Instead of 10 and 12 horse power engines, those of 40 horse power came into use. The furnaces and boilers were made for burning straw, on new methods, and the industry expanded to large proportions.

Later on the "combined" machines came into use, performing, as before explained, all the operations at one time, and just now the effort is being made to not only drive the threshing part of these machines by steam power, but to propel them as well.

One of the members of this Society has, during the past summer, spent large sums of money and several months of his time in the field studying the problem of operating these vast harvesting machines entirely by steam power.

The agencies and resources drawn into this single operation of harvesting wheat in California may well be set off against all that has been done elsewhere, the world over, during eight years past.

Most notable among the technical achievements of this Coast, and mainly among men who are members of this Society, has been the founding of naval architecture and marine engineering. It is hard to realize that this great and most difficult of all industries has been built up here in five years past, and in a manner not surpassed if equalled on this continent. The Union Iron Works have constructed some of the best vessels in the United States Navy, and of nearly all classes. On the 14th inst. the first rivets were driven in battle ship *Oregon*, an armored vessel of 10,000 tons, and of the first class.

As a measure of the ability and skill brought to bear in this works, they pay nearly one cent a pound for transporting material from the East, eqnal to 30 per cent. of its value. They pay a rate of wages 33 per cent. greater, and yet have competed successfully with Eastern firms for these war vessels. With some knowledge of the subject at home and abroad, I will claim that their implements, methods and processes, also their management and engineering skill is superior to their competitors. It is a great industry, of which we may well be proud, and is ably supplemented here by the other works, where one may order a steamship, a locomotive, or a countershaft, and all will be made in due course.

There are other cases of the kind, among which may be mentioned a wonderful system of urban railways in San Francisco; subaqueous dredging by various ingenious machines. The development of tangential water wheels; the conduction and application of water under enormous heads, and, most of all, in the construction of large ocean steamers for both war and commerce. It is not necessary, however, to revert to these matters. The local record of engineering, architectural and mechanical achievement is extensive, creditable, and, as before said, out of all proportion to the limited population of this Coast.

There is now rising into promise a new field that will, before long, tax the resources of the engineering professions; that of the conservation and distribution of water for the purpose of irrigation. Looking to what has been done in Egypt, India, Australia, and the mountain states of this country, and comparing with the future possibilities on this Coast, this problem becomes amazing in extent, and also in intricacy. Elsewhere irrigation is carried on under circumstances much more uniform in respect to varying precipitation, evaporation, varieties of soil, the torrential nature of streams, the volcanic and disturbed character of the earth where basins and canals are to be made, the peculiar and varied crops that are grown, and the lack of laws to define and regulate the control and apportionment of water.

There is, also, the great problem of supplying to commerce some other means of intercourse with the world than has hitherto been enjoyed, and without which all interests here must languish in future.

The best scheme, and incomparably the best one to improve the trade, and, consequently, all interests of this City, that has been presented in a public way, has been by an engineer, a charter member of this Society. Not only this, such presentation has been accompanied by certain propositions of an economical nature that serve to show the intimate relation between the technical and commercial branches of the subject.

The future of the Pacific Coast is mainly in the hands of those engaged in the technical professions. The problems are physical ones rather than commercial, and even if not, the commercial element has too close a relation with politics to much concern itself with the commonwealth. Commerce is competition, and a merchant's concern and ambition is apt to extend only to his immediate environment. He is not watching and studying the progress made elsewhere. That is no concern of his, so long as such progress does not interfere with his business.

I want to draw no disparaging comparison between technical, manufacturing, and commercial pursuits. All of them are necessary, interdependent and honorable, but what I do assert is that, in the nature of things we must look for progress and improvement elsewhere than in the distributing trades of this City.

The term commerce, we must remember, however, covers two very different pursuits. A merchant, in the true sense of that term, is one who equalizes and distributes the products of the earth. He moves the fruits of California to countries where such fruits do not grow; brings the tea of China here, where it cannot be produced. He carries out gold, silver, mercury, timber and salmon from the Pacific Coast and brings back in return iron, fuel, cloth, and various fine manufactures. This is commerce, and is something quite different from the distributing trades which divide and parcel out commodities in small or broken quantities to suit consumers. This branch of trade is what is called in England shop trading, and is the kind, I am sorry to say, best known here in San Francisco. The other kind, the merchant trade, will come with Mr. Dickie's steamers. With this much of local and personal affairs, I will now attempt, in a compendious way, some review of the progress, discoveries, and great works of the past year.

The Nicaragua Canal I need not mention, as our committee appointed to watch and report upon progress made in this great work will, at an early time, present such facts as have interest to the Society. As to the national and economic phases of the subject, it may be remarked that there is a persistent effort to create another of those partnerships between the nation and private shareholders, which has proved so unsatisfactory in the past, and for which there is scarcely a precedent in any other country. The canal should be made either as a government work or as a private enterprise, perhaps the former, perhaps the latter, but certainly not a combination of the two, unless the money voted is considered as a bonus or gift to a company.

Government ownership, to the extent of an investment of public funds, sounds well as a business proposition, but, except the money advanced by the government to the Centennial Exhibition, at Philadelphia, I think it will be hard to show that funds, so loaned by the government have ever been paid back in kind, or otherwise.

The Manchester Canal, respecting which no estimates need be given here, is, no doubt, the greatest engineering work going on at this time, and is mentioned only to call attention to a very earnest inquiry in this country into the cost and advantages of inland water ways now engaging much attention all over the world. In this country there has recently been in Detroit, Michigan, a water-ways convention to consider the subject as it applies to the great chain of lakes, and their connections. A second convention of the kind has more recently assembled in Kansas City, Mo., to consider the improvement of navigation in the Mississippi valley, and the next in order should be a similar convention on this Coast to consider the navigation of the rivers in the great valley of California.

This consideration of waterways must, at first, be a commercial problem. Engineering facts will not have much interest until the cost of carriage compels such attention. In all countries, to some extent, but in this one to an enormous extent, the railway power has successfully pursued a policy and imposed restrictions that have nearly destroyed river commerce, and the awakening of the last six months to some realization of this fact, portends, let us hope, greater movements for the future.

Closely allied with this is the subject of irrigation, or an artificial distribution of water, that will save, to some extent, the vast surplus that passes off to the sea, and which is, so to speak, the vital element of the principal industries on this Coast. Space will not permit a review in detail of what has been projected or done. The subject, in its latest phase, that is, on an extensive scale, is quite new in this country, but is as sure to be a field of much activity in the near future. In Egypt, the operations of British engineers are fast transforming that old country, and making it again as it was in ancient times, the seat of the most dense population that the world has ever known. The revenues from rented lands in Egypt, tributary to the canals was, last year, more than twenty-five millions of dollars. The population of the irrigated districts is set down at 5,800,000. The area watered is 8,840 square miles. In Australia the same work is going on successfully, and large grants of money have recently been voted in Victoria for irrigation purposes.

On this Coast, the problem of irrigation is much affected by the question of evaporation from impounded water, canals and ditches, and it was hoped that, during the past year, a paper bearing upon this subject would be presented before this Society, giving some data of value. The maximum evaporation set down for Madrid, in Spain, some portions of British India, and at Salt Lake, in Utah, approximates half an inch daily during the dryest periods, and during the summer months here must consume a great share of the water held or conveyed in the open air.

Great works and problems in civil engineering exist on all sides. Tunneling under rivers and straits has been reduced to an almost exact science. The great Siberian railway shows that no physical impediment can stop the path of the engineer.

The improvement of rivers and harbors by the general government I think had better not be mentioned. So far as this Coast is concerned, there seems no complaint, but on the Atlantic side the record is not one to call for commendation when compared with the achievements of private enterprise.

In mining engineering, which seems to embody nearly all other technical branches, a culmination of the art seems to have been reached on this Coast, or at least present effort has been narrowed down to details, and more directed to metallurgy, chemistry and geology, than to mechanical implements and processes. A mining engineer must be possessed of that qualification Mr. Carlyle called *gemeinlichewissenschaft*, or a knowledge of all things in general. A wide profession, with a wide field, and an eminent following on this Coast and in this Society. One of our active members has recently been appointed on the staff of the largest electrical company in the East, indicating what may be learned here by a young man not thirty years old.

The architects, who have always formed an important section of this Society, do not need mention, because their works show for themselves. The substitution of metal for masonry and wood, has rapidly called upon the profession for new qualifications of an extensive kind. Our City, and others on the Coast, even without streets, compare favorably in architecture with any others in the country, and the profession may well claim to be abreast with their co-workers elsewhere.

In mechanical engineering work, with which I am most familiar, the past year has produced, for one thing, a wide expansion of implements and processes for heavy forgings. Heretofore, this country has been much behind in what may be called heavy steel and iron working, but the great plant at Bethlehem, Pa., and others, have enabled orders to be filled for the heaviest forgings required for naval and war purposes. There has also been a great advance in the construction of small arms and ordnance, also in armor and other material of war.

It would be much preferable to mention such an expansion of inventions and methods to serve some useful and peaceful purpose, but at present in our own, as well as other nations, a large share of human effort is sacrificed on the altar of barbarism, and a spirit of destruction, that is sometimes mistakenly called patriotism.

As remarked, a great share of mechanical engineering effort has gone in this direction. The torpedo matter alone has absorbed much ingenious effort, and the expenditure of millions on a mode of warfare that should be deprecated among all civilized nations. These inventions and wealth for the destruction of human life and property, may be called an essential part of our civilization, but it is discouraging to think that about one fifth of human effort—one working day in five—must be devoted to such a purpose.

To mechanical engineering, in a sense, must be credited some of the efforts of the past year to accomplish aerial flight, and, for the first time, such effort has followed what may be called scientific methods. The only ultimate purpose to be gained, so far as now appears, will be a further contribution to the destructive fund, for war purposes. No engineer who has considered the matter, is likely to attach much importance to sustaining passengers and merchandise in a fluid that weighs .08 of a pound to a cubic foot, when the same weight can be rolled along on iron ways with a frictional resistance of ten to twenty pounds per ton. It is, I think, a field of inquiry that this Society may safely ignore.

There have been no startling discoveries in what may be called constructive engineering, and it may be safely doubted whether there ever will be in future. Evolution in the constructive arts is now narrowed down to matters of detail. Exact methods and computed results have supplanted empiricism and discovery. The world moves together in these things. There are no national lines. Technical knowledge has escaped race prejudices, the custom house, and ecclesiastical control. This Society is in touch with all others of its kind, in all parts of the world, and in this free interchange respecting technical research, rests the prodigious advances of our time in all of the useful arts.

Of that new and, I was going to say, magical field, electrical science, the past year has been more fruitful in adaptation than discovery, and when we consider that all the main phenomena and functions dealt with, are amenable to computed quantities and results, it is not likely that the period of discovery will be lengthened out over several ages, as in the case of older branches like steam, which is, even now, or until quite recently, less a science than electricity is.

The difference is in resources, as well as methods, or, as may be said, electrical science began where most other branches left off. There are many here, no doubt, who can remember when the thermal problems in steam power were not thought of in practice, also when heat was only recognized as a condition of matter, and not an element of primal energy. It is not long ago, but was before electrical science came to the front, with even its nomenclature determined by the consensus of learned men.

This new science imposed an extensive draught upon the resources of practicing engineers, civil and mechanical. It was a new branch suddenly added, dealing with an intangible element, not amenable to their methods and implements, but pervading their field of practice. In colleges it added at least one fourth to the curriculum, and qualified, or affected indirectly much more. What its future connection with the industrial arts is to be, no one can foresee. Its relation to heat and light lies hidden in occult phenomena, and laws that give but little hope of early solution, but to be made plain some day no one can reasonably doubt.

If space permitted, it would be a pleasure to extend these remarks to various other technical pursuits; the production of high grade scientific and mathematical instruments, the thorough laboratory practice and other branches which our diversified membership embraces.

In conclusion it will be proper to revert to the fountain head, so to speak ; the teachers, on whom depends the membership of this Society when our day has passed—the faculty of our technical colleges. They have, to a great extent, aided and promoted this Society by contributions, counsel and membership. To them we stand much indebted, and are anxious to increase the obligation.

In the wide and bewildering field, which has barely been hinted at, our Society must dig and delve after new truths, each member contributing his part, and here let me say that his part may be a very useful one, if he does no more than come to hear, and aid us with his presence. The courtesy that has marked the proceedings of the Technical Society is such, that no one need fear a respectful hearing of what he has to present, or say, and it is hoped in this term of 1892, there will be a wider participation in the proceedings by all, and especially the new members.

Some debate followed the Annual Address, after which the Secretary's annual report was presented, read and accepted. The report is as follows :

REPORT OF SECRETARY FOR 1891.

I have the honor to submit the following report of the condition of the Society and its progress during the past year:

The present total membership is 201; as follows:

Honorary members	2	Juniors	5
Members	177	Associates	17

Of these, 141 are resident, and 60 non-resident. A geographical distribution places in

San Francisco and vicinity	141	Illinois	1
Other parts of State of California	37	Massachusetts	1
Arizona	1	Minnesota	1
Colorado	1	New York	1
Idaho	1	District of Columbia	1
Nevada	3	England	1
Oregon	2	Hawaii	2
Washington	3	South Africa	2
Utah	1	South America	1

Professionally divided, there are:

Architects	4	Military Engineers	4
Builders	1	Mining Engineers	27
Chemists	5	Naval Architects,	1
Civil Engineers	73	Professors of University	5
Draughtsmen	2	Scientists	1
Electrical Engineers	2	Surveyors	7
Instrument Makers	2	Technologists	4
Marine Engineers	2	Associates of various callings	17
Mechanical Engineers	44	Total	201

During the year 1891 the Society increased in membership as follows: Admitted, 56; reinstated, 1; total, 57. Of these there are

Members	45	Juniors	4
Honorary Member	1	Associates	7

Professionally divided:

Chemists	1	Mechanical Engineers	11
Civil Engineers	23	Mining Engineers	3
Draughtsmen	2	Professors of University	2
Electrical Engineers	1	Surveyors	4
Honorary Members and Associates of various professions	8	Marine Engineers	2
		Total	57

[*Continued.*]

Membership of Society January, 1891 :

Members and Associates	149	Increase in 1891	57
Total Membership in 1891	206	Resigned during 1891	5
Gain in 1891	52	Present membership	201

The resignations during the year are :

Alpheus Bull, San Francisco.
Thomas Hamlin, West Virginia.
P. H. Jackson, San Francisco.
J. G. Pohle, Denver.
A. W. von Schmidt, San Francisco.

The following juniors, entitled to full membership, will be placed on that list :

Franklin Booth. Ernest McCullough. R. E. Bush.

Number of regular meetings held during the past year	12	Directors' meetings	8
Public meetings	2	Special meetings	1
Number of addresses made	1	Number of papers read	14
		Discussion of topical questions	4

Papers were published in the printed preceedings of the past year on the following subjects :

Street Pavements in San Francisco.
Abrasive Processes in the Mechanic Arts.
Bridge Analysis.
Physical and Geological Traces of Permanent Cyclone Belts.
Hall's Hydro-Steam Elevator.
Cause of the Glacial Period.
Nicaragua Canal.
Act to Define the Duties of Land Surveyors.

Contributors :

John Richards.
Robert Hinchliffe.
Hubert Vischer.
Irving M. Scott.
Naval Constructor Stahl, U. S. N.
Jerome Newman.
Louis Falkenau
Commander H. C. Taylor, U. S. N.
S. Harrison Smith.
Marsden Manson.
T. W. Morgan.
George W. Dickie.

A board of examiners for State licensed surveyors was appointed by the Governor. The chairman and two of the members were chosen from the Technical Society, to-wit :

Luther Wagoner. S. Harrison Smith. L. F. Bassett.

Applications of 94 surveyors for a license were examined, acted upon and passed during the year.

OTTO VON GELDERN, *Secretary.*

TREASURER'S REPORT FOR 1891.

The report of the Treasurer was then presented and referred to the Committee on Finance.

To the President and Directors of the Technical Society of the Pacific Coast:

GENTLEMEN: I have the honor to make the following detailed report of collections and disbursements, assets and liabilities for the past year:

RECEIPTS.

Received from former Treasurer	$ 80 98
" " members for dues	1,478 00
" " admission fees	230 00
" " special subscriptions	192 50
" " room rent from Cal. Chapter Architects	60 00
" " sale of transactions of T. S. P. C.	57 50
" " " keys to room	3 30
Total	$2,102 28

DISBURSEMENTS AS PER VOUCHERS.

Room rent	$ 460 00
Secretary (13 months)	325 00
Collector	150 07
Janitor and office expenses	128 21
Stationery	33 45
Postage, carriage and duty on books	133 00
Printing and typewriting	510 47
Binding books	29 05
Engraving	69 25
Furniture, fixtures, and moving to present hall	259 90
Total	$2,098 40

ACCOUNTS RECEIVABLE.

Unpaid dues (to January 1st, 1892)	$ 542 50
Admission fees	55 00
For transactions T. S. P. C. (sold)	14 00
Keys	70
Room rent due from California Chapter Architects	20 00
Total	$632 20

ACCOUNTS PAYABLE.

Geo. Spaulding & Co. (printing)	$ 447 55
Britton & Rey (lithographing)	65 00
California Camera Club (furniture)	27 06
Edward Denny & Co. (stationery, etc.)	5 95
Advertising	5 70
Rent for December	40 00
Total	$591 26

SUMMARY.

Accounts receivable	$ 632 20
" payable	591 26
Balance	$40 94

Collections for the year	$2,102 28
Disbursements for the year	2,098 40
Balance	$3 88

GEO. F. SCHILD, *Treasurer*,

REPORT OF THE NICARAGUA CANAL COMMITTEE.

The Nicaragua Canal committee appointed by the President, consisting of Messrs. Ross E. Browne, A. T. Herrmann and Otto von Geldern, make the following report, which the chairman herewith submits:

A correspondence was begun with the manager of the company, in New York, who thereupon submitted to the Society copies of certain plans showing the location of the Atlantic section of the canal, with the topography of the country, and a corresponding profile of the proposed alignment. A general study has been made of the conditions from these drawings, but no official report has as yet been written. The Traffic Association, recently organized in San Francisco, has also taken up the subject of this canal. A committee has been appointed by that organization to discuss and report upon the commercial aspect of the enterprise, and to advocate this water-way as an advantage to the future ocean traffic of San Francisco, and as a means of improving the stagnation in the commercial conditions of California. Arrangements have been made with that committee by which the committee from the Technical Society will represent in any council the engineering features of this great project.

The work has therefore just begun, and whenever the matter is to be publicly discussed, our committee will have a full report to make, in which the physical and technical points of the proposed work will be explained as far as the accessible data will permit.

The committee therefore asks for further time, reporting progress.

Otto von Geldern, *Chairman.*

The next regular meeting of the Technical Society will take place at their rooms, 819 Market Street, February 5, on which occasion Mr. D. C. Henny, C. E., will present a paper on Wooden Conducting Pipes for Water, as now applied in some works in this State. These pipes are made of staves joined in a secure and ingenious manner to resist high pressure, and at a cost that rivals metallic pipes. The subject is one of interest at this time.

Notes and Comments.

The United States armored cruiser *New York*, recently launched at Philadelphia, is 380 feet long, beam, 64 feet; draught, 23 feet; displacement, 8,150 tons; speed, 20 knots, and collective power, 18,000 horse power. There will be four separate engines, with cylinders 32, 46, and 70 inches diameter. The battery will consist of six 8-inch rifle guns, and about twenty auxiliary guns of one kind and another. The cost of the vessel is to be three and a half millions of dollars, exclusive of armament, or, in all, over $4,000,000. The rudder frame for this vessel was forged in Cleveland, Ohio.

In the report of the Chief of the U. S. Bureau of Naval Construction, it is recommended that all vessels of less than 1,000 tons displacement, intended for general use and cruising, should be of the composite type, with iron frames and wood planking, so as to be copper sheathed; also, that all larger vessels intended for general service in foreign waters should be sheathed. The fouling of iron and steel vessels is the greatest problem to be dealt with in modern war vessels that have to lie for months in tropical waters, and become in that time almost helpless in respect to speed. The search for anti-fouling paints has not resulted in much this far, and gives little hope for the future.

The *Engineer*, London, has recently published a description of the London postal and telegraph system, that occupies 22 pages, and has more than fifty illustrations, mostly devoted to the pneumatic system of transmitting, which has become wonderful in extent and nature. The power for the pneumatic apparatus at the London post-office requires four beam engines of the compound type, the high pressure cylinders being 17 inches and the low pressure 25.5 inches diameter, making in all at least 800 horse power. There has been a kind of race between the London and Paris pneumatic systems, which are very fully discussed in the late report of the Postmaster-General, not written by him, however, as the absence of the personal pronoun indicates.

The armor plates of American make that have recently been tested at Indian Head, seem to indicate that we have began where other nations left off in that kind of manufacture, and there is certainly no impediment now to furnishing the plates required for the *Monterey*. It would be more pleasure to congratulate our steel works on some achievement in the useful arts, but whatever makes good armor plates will be equally good for some other purposes. There has been established at Philadelphia a factory for making "celluloid" of cocoa husks, for preventing water from entering hulls of vessels pierced by shot. It is a scheme that has met with some attention abroad, and is a branch of the armor problem.

The blast furnaces built in England to plans furnished from this country, have turned out just as we expected, that is, the experiment has shown that the largest out-put here is not owing to furnace construction so much as the ore, and, especially, the manner of operating the furnaces. The product at the Edgar Thompson Works, with which comparison was made, was largely due to the higher efficiency of labor, natural gas, and various mechanical appliances that were wanting in the experiments in England. Some years ago we came direct from England after visiting works in Barrow and Sheffield, to Pittsburg and Braddock, and while some notes then made, are not now at hand, we remember the labor cost per ton of rails was not more than two thirds as much at Braddock as in the English mills.

Mr. P. J. Flynn, C. E., who was for many years engaged on irrigation works in Asia and later in this country, has in press an extensive and comprehensive treatise on this branch of engineering. This work will be ready during the coming month, and has been extensively subscribed for among the profession and others. Mr. Flynn, besides his experience in irrigation works, is well known by his admirable rendition of the Küter and other formulæ relating to the flow of water in conduits of all kinds. He brings to his aid a thorough college and field training, with ten years of experience on hydraulic works in India and sixteen in California. The work named will contain 800 pages of matter, forming the most complete reference that has ever appeared on the subject. A more extended notice of it will be given in our review columns, after its publication.

The Board of Trade in Humboldt, California, have memorialized Congress respecting appropriations for improving that harbor, and have certainly presented cogent reasons for a grant of such proportions as will enable the opening of that port for deep vessels, if that be possible. The memorial says that since 1872, or in twenty years past, 125 vessels have been built in Humboldt Bay, and that a total of $4,000,000 worth of merchandise is sent out from there each year, also points out that there are few harbors on the Coast, and none for a distance of 600 miles so safe as the one at Humboldt, which is just half way between the extremes of the American Pacific Coast line. The harbor has a tidal area of 24 square miles, and the modest appropriation of $700,000 asked for should be speedily granted.

Mr. David A. Wells has been making some computations on silver, and finds there are now in the vaults of the U. S. Treasury $400,000,000 worth of that metal. This makes 11,000 tons, and the Government is buying every week 42 tons additional, to add to this store. The stored silver furnishes an interesting subject for computations. A cubic inch of silver weighs 0.38 pounds, and a cubic foot 657 pounds, so there is on hand 33,500 cubic feet. It would take 220,000 men to carry it, each carrying 100 pounds. If coined into dollars and piled up in a column, it would reach 675 miles. This immense amount of silver is in dollars, $348,341,193; small coin, $15,848,620; silver bars, $41,579,253; trade dollars, $2,394,260; total, $409,161,326, and yet buying seven tons a day.

Ship building on the North American lakes can not only boast of a phenomenal development in tonnage, but also in architecture, design and general excellence. The *Virginia*, of which the *Marine Review* recently published one of the finest engravings of a vessel that has ever appeared in this country, has all the requirements of trans-ocean steamers, and some that they lack. The vessel was built at the Globe Iron Works in Cleveland and is a great credit to their skill. The whale back scheme will detract some from the progress that would have been made in building regular steamers of the freighting class, and it is an open question whether such an invention will in the end be for the best. They may carry cheaper, and ought to, in compensation for the outrage on symmetry in naval architecture.

Mr. George Rutledge Gibson has furnished in the *Engineering and Mining Journal* an essay on the free coinage problem that contains, among many other points, one that can not be too widely disseminated, namely: That for the government to issue securities against lands, metal, grain, or anything else, is simply buying these commodities outright. This is certainly the fact, and its cogency lies in the further fact that it places the scheme of free coinage in the same category with a hundred more where the National Treasury is to be assailed in the interest of private persons. We are drifting at a headlong speed toward the dangerous and debasing assumption that the money collected as taxes, for defraying the expenses of the nation, is the proper prey of any one who can devise means of "getting it out of the Treasury."

The following notice has been issued by the American Society of Engineers, setting the time of the San Francisco meeting for May. The professional sessions to begin on Monday, the 16th, and to last for four days. The party will leave New York in special trains on May 4th, at 9:30 A. M., by the West Shore line, and the minimum of absence is estimated at 21 days. Messrs. Raymond & Whitcomb, 257 Broadway, New York, will have charge of the trains and will forward to each member a memorandum of the trip, and excursions connected with it. Papers to be presented at the San Francisco meeting must be sent to the secretary by the first of April, or before. It would be a fitting thing for some of the Pacific Coast members to contribute papers at this meeting, but the time is now rather limited for such a work by any of our active engineers, who commonly are very busy at that season of the year.

Captain Edwin Bell, of St. Paul, Minn., will no doubt visit this Coast next Summer, and while here the San Joaquin Canal Commission, appointed at Sacramento on the 21st ultimo, should secure his services, in so far at least, as to go over the line of the proposed improvement of the San Joaquin River. Captain Bell, as was explained in our September issue, last year, was, in fact, the inventor of the methods employed by Captain Eads in opening the mouth of the Mississippi river, and has constructed dams and other works in that turbulent stream for a quarter of a century past. Captain Bell is now in consultation with a board at St. Paul and Minneapolis, respecting the improvement of the channels in the upper Mississippi. His extended observation and knowledge of such matters is the work of a lifetime, and his advice would be of great value to the San Joaquin Improvement Commission.

The visit of two Russian mining engineers to this City last month, after their inspection of various mines and appliances in Nevada County and elsewhere, should be an opportunity for the makers of mining machinery to form a connection for the Siberian trade. We received, some years ago, from a prominent engineer in St. Petersburg, a request to forward to Siberia, circulars and other information respecting California mining machinery and appliances, and as now remembered, the cost of carriage was less from here than from Europe, and, of course, less the railway carriage from the Eastern States. Formerly there was one vessel a year loaded here for the Amoor River district, mainly with goods sent overland from Boston. The engineers, named Messrs. Bergdanoff and Levinsky, propose to introduce in Russia a good many of the inventions they have found here, especially for gravel and sluice working.

Prejudice is one of the least understood of human traits. Its strength is not even suspected, and especially when developed in connection with that sentiment we call "patriotism." Neither is it confined to sentiment, nor to ignorant people. It has its place in connection with engineering and mechanics as well as in politics and religion. Some years ago, one of our prominent mechanical engineers, well informed in his circle and pursuits, but without any practical observation beyond, took a number of the *Engineer*, London, which had about forty pages of advertisements filled with illustrations, and remarked: "Is not that wonderful, there is page after page of things that are absolutely worthless." He thought so in good faith, because these things differed from what he was accustomed to. The engravings showed what may be called advance practice among nine tenths of the civilized nations of the world, but to him they were monstrosities. He knows better now, and sometimes lectures his friends on the subject of "their prejudices."

It has been the custom in this country, when it so pleased the powers, to appoint soldiers as postmen, or mail distributors. The English postmaster-general has gone further, and announces that he will in future make all appointments of carriers from soldiers who have honorable discharges. This means a kind of revolution in certain lines, and will greatly promote enlistment in the army, which has been a great problem in Britain for a hundred years past. Since they have become a trading and manufacturing nation, enlistment has been difficult, because of there being employment for the people, and also because of the sentiment against war common to industrial pursuits in all countries. This move of the postmaster-general in England is a shrewd one, because all soldiers who are honorably discharged draw small pensions, and the chances are that the postman service will, for that reason, be secured at a reduced rate.

A contemporary remarks that it is likely that all rubber compounds will eventually give way to hydro-carbons and other oils for insulating cables or other electrical conductors. This seems a strange prophecy in view of the fact that oil insulation was invented by Mr. David Brooks, of Philadelphia, twenty-five years ago, and applied in laying subaqueous lines by means of pipes filled with petroleum oil surrounding the wires. We were acquainted with Mr. Brooks, and can remember the great importance he attached to this invention, which has, however, not come into use. It is the old story of evolution, perhaps. No invention of the kind, or of any kind, for that matter, bursts full bloom upon the world. It must pass its period of probation. Mr. Brooks devoted much time and effort to his discovery. He placed experimental lines across the Schuylkill River at the beginning, and claimed that insulation was complete.

The *Locomotive Engineer* for January, contains a fine portrait of Isaac Dripps, a locomotive engineer and railway manager of eminence, who is 82 years old, and is yet an active man. He has held very responsible positions for 40 years or more, and was for a time superintendent of motive power for the Pennsylvania lines, the most important charge of the kind in this country. Mr. Dripps put the locomotive "Johnny Bull" together at Bordentown, N. J. This engine was brought out from England, and was driven by Mr. Dripps on the Camden and Amboy lines in 1831, sixty-one years ago. We knew Mr. Dripps personally, and can bear witness to his great mechanical ability by having constructed under his instructions various special implements to facilitate railway work. The portrait recalls many things connected with his remarkable life as an organizer and mechanic at a very early time in American railway experience—from the very first, in fact.

It is of the nature of an axiom to point out that an increase in the cost of material used in the manufactures must reduce the amount of wages paid for labor, and we now claim that the logic of facts proves the proposition. Such a result on wages is inevitable, if the price of the product is not increased. What is added to material must be taken from wages, or from profits, and it has been taken from wages accordingly, from one end of the country to the other. Cheap material and high wages can go together, but not dear material and high wages, unless we want to ruin our industries. Suppose, for example, that iron was reduced 50 per cent. in price; does anyone suppose that would reduce wages in the iron trades, or would it raise wages. The two things taken together must constitute a definite sum, or element of cost.

There was held at Chicago on the 16th of December, last, a meeting of certain makers of wood working machinery, with the object of forming a combination of this manufacture, which can not be viewed in any light other than a joke. There is no probability, or possibility of any such combination for a variety of reasons, principal among which are, that not one half of the firms engaged in that business would enter into any engagement controlling their affairs. The manufacture is too varied, and not uniform enough for such a scheme. There are, indeed, very few machines in the large number made, that are uniform enough for a set price, but these are not the only impediments. The manufacture, if it can be so called, is an exposed one, that, outside of a few inventions, can be carried on anywhere, and has all the time been crowded to overflowing by people and firms not regularly trained in the business.

In the last issue of INDUSTRY were some comments on naval engineers, and circumstances reported since then show that this branch of the service in England, where all professions are much crowded, cannot be filled for want of applicants. The admiralty recently offered places for twenty-seven assistant engineers who were to pass examinations, and received only two applications. Forty two vacancies in a government training college called out only fifty-three candidates of which only a small part were successful in examinations. This indicates the widening of the merchant service, which is better paid, but not much, the difference in no way accounting for a want of applicants. The nature of the service is one thing. War is not a natural pursuit ; it is distasteful in every way to a large share of people, and the best share of people besides. The privilege of choosing one's movements and *habitat*, or confining it to some findable place, are considerations of weight. This repugnance to naval service may be a misfortune, or it may not, certainly not, if it is universal.

It is not thought necessary to occupy space in these columns devoted to the Chicago Exposition, because of the voluminous and complete reports that appear elsewhere, and especially in the foreign journals, which have graphically and otherwise devoted an exceptional amount of space and expense to this subject. The progress made with the buildings and all connected affairs show an amount of energy characteristic of the country, and the wonderful resources it possesses. What the contribution from this Coast will be, other than natural products, is not clear. Of these there can be a wonderful display, but of manufactured products, which are the main purpose of such exhibitions, we fear the amount sent from this Coast will be a meager one. A lack of it will not be for want of resources, but a want of incentives. In the Eastern States exhibits will be made to promote sales, that, indeed, is the main purpose of exhibiting, but we have no sales to promote in the way of skilled products, because, with the exception of patented articles, there is little hope of trade from here, beyond the mountains. As however a thrifty population is the great want of this Coast, a display of natural products may much help that object, and must, in any case, command considerable interest.

This City has enjoyed the unenviable distinction of producing a steam jet wheel that, we are solemnly assured, develops one horse power with 8 pounds of water per hour. Considering the careful, or even exhaustive investigations made in this direction by Mr. Parsons and others during three years past, and which have been set forth from time to time in INDUSTRY, one must conclude that the space thus allotted has been wasted. Mr. Parson's engines, made with an exactness and skill that cannot be excelled, expanding and reversing the current nine times with clearances of less than $\frac{1}{100}$ of an inch, required, as now remembered, more than 40 pounds of water per horse power, and that was within a very small amount of what he had set down by computation as the probable result. A good many of these steam wheels or engines have been made for special purposes, but requiring in all cases, so far as we know, about double the amount of steam for a given quantity of work that a good steam engine does. A steam hurdy-gurdy wheel should consume 50 pounds or more of water per horse power, and doubtless does.

Mr. George Dickie, of the Union Iron Works, some time ago, in speaking of his shop apprenticeship, said the walls of the fitting department there were marked with vertical and horizontal lines, the latter made perfectly level, so that anything not requiring great accuracy, could be set by sighting these lines on the walls. It seems a very good expedient for erecting shops, and will serve as a text for saying that there is too much neglect of wall and floor marks in our factories and shops. In a new building that is to contain machinery there should be made through its center, both on the ceiling and floor, permanent lines that can be referred to at any time in the future. If a machine or a countershaft is to be erected, they are set to these lines the same as the shafting, engine and indeed, other machinery of every kind have been. For a ceiling line, a good plan is to bore holes every ten feet or so, into which pins can be driven to attach lines to if required. The holes can be intersected by a "scribe line" and one or two cross lines are convenient. On floors, where marks are apt to be obliterated, the lines should be cut in with a scribing hook, and in that way will remain so as to be found as long as a building will last.

LITERATURE.

Cassier's Magazine.

This publication, of which we were able to make a very favorable notice in our November issue, is again at hand with, if anything, an improvement on the first number, and has for its first article a historical essay on the American Society of Mechanical Engineers, with finely executed portraits of the President, Secretary and Treasurer of that Society.

Short biographies are given of each of these officers, and some account of their eminent positions in the profession to which they belong. This article will have especial interest, at this time, to the people on this Coast, in view of the intended spring meeting in this City, which will be attended by 300 or more from the Eastern States and other countries.

The second article, by Professor R. C. Carpenter, on "The Technical Schools of America," gives an interesting description of Sibley College, Cornell University, with photoplate views of various parts of the interior, including the foundry, testing room, machine shop, smith shop and laboratory.

This college has been rendered famous, first, by the methods of instruction pursued by Professor John E. Sweet, and since by the administration of Prof. R. T. Thurston. "Sweet's boys" are known all over the country and have never failed to find places in which to show what they could "do."

The story has been told many times of Prof. Sweet's celebrated address to the graduating class, but it will never grow old. He said: "When you young gentlemen go out into the world to apply what you have learned here, you will find that no one will pay you for what you 'know,' but only for what you can 'do.'" This is a truth far from understood. A man with all the learning of our day, has no value in any business outside of what he performs. What he may know is in the abstract, and has no money value.

Articles on steam jackets, water ram in pipes, electric power distribution and various technical subjects by well-known writers make up a valuable number.

Streets and Highways.

DEPARTMENT OF STATE, WASHINGTON, D. C.

This volume of near 600 pages is one of the most voluminous that has been issued by the Bureau of Statistics, relating to a branch of public engineering work in which our country is notoriously deficient.

It is not the purpose to attempt any review of the volume. That would be impossible in so far as segregating sections for comment. It is a kind of connected whole, and will be found of great value to engineers and others interested in public works. One reflection in connection with the work is: How can the people in even the poorest countries manage to make such highways as are described?

The work consists of a series of reports from Consuls and Consular Agents of the United States, compiled from observation in some cases, but mainly from public records in the various countries, among which are Australia, China, and even Ceylon.

Some philosopher has claimed that the civilization of a country is indicated by its roads, which, like some other sayings of philosophers, requires modification. As a matter of fact, the quality of roads depends on how far the commonwealth or the individual is the ruling power in a country, and for that reason we find good roads in all countries having a centralized form of government, and bad roads wherever there is a popular government.

In a popular government, like ours, no one is apt to concern themselves about roads, except on their own premises, or where they are compelled to travel, and public funds must be dispensed with respect to localities and people. The construction of highways is some time to be a more important question in this country, and just how the matter is to be managed is not clear. The present work is addressed to how roads are made, meaning the methods of their construction, and as such is valuable, but the main question now is how are the funds to make roads to be collected, how disbursed, and by what power can people be compelled to construct them?

Engineering Magazine, January, 1892.

In the first article in the present number, Mr. George Y. Wisner, civil engineer, presents an arraignment of the U. S. Engineer Corps, which, if warranted, should command the serious attention of Congress. It is by no means the first literature of the kind that has appeared recently, and were it not that for many years past, there has been a kind of common consent to continued failure of river and harbor improvements by that bureau, more serious attention would be given to the subject at this time. Some allowance must always be made for professional jealousy in comments upon, or by, a class of engineers, governmental or civilian, but facts, when presented, do not admit of such qualification. Mr. Wisner says:

"Appropriations amounting to millions have been expended in various harbors where the works, so far as completed, show no amelioration of the original condition, and what is still worse, indicate that the expenditure of any additional amounts under the same plan would produce no better results. The negative result of the harbor works at Charleston, S. C., is typical of the condition of affairs at most of the harbors on the South Atlantic, Gulf and Pacific Coasts, where it has been attempted to improve the channel entrance. In the last annual report of the Chief of Engineers it is estimated that $3,132,000 will be required to complete the improvement in Charleston harbor in accordance with the plans adopted in 1878. The estimated cost at that date was $1,800,000, and $2,203,500 has already been expended upon the work. According to the latest charts of the harbor the average depth of water on the bar is approximately the same as in 1878. Since jetties, however far completed, should produce the same effect through the section of channel between them as when carried to any greater distance seaward, it is evident that to continue the work under the present plans will be a deliberate waste of public funds.

Previous to 1883 the Army engineers expended $1,578,000 in attempts to deepen the channel across the bar at Galveston harbor, which resulted in a total improvement in depth of only one foot—a rate of increase in depth at which it would require 340 years to complete the improvement desired. Captain Eads, at the request of the citizens of Galveston, made an examination of the harbor, and offered to enter into a contract to obtain a permanent thirty-foot channel across the bar, and guarantee results for the sum of $7,750,000. This project the Army Corps succeeded in defeating. They have since formulated a plan for the improvement, which they have estimated to cost $7,000,000, but which, under the contract recently let, will require at least $9,000,000 to complete. Thus, it is evident that the Government will be required to expend $1,250,000 in excess of the amount necessary to have a permanent channel guaranteed in order to allow the officers of the Corps to experiment with plans which scarcely one reputable civil engineer believes will succeed."

That Mr. Wisner has presented this subject in all of its phases, we very much doubt, especially as respects work done at Galveston, and perhaps in other cases where "railway" interests are threatened by the improvement of water-ways.

There is no doubt of the expediency of contracting all work of the kind. Especially as it is pointed out by the author, the cost is much less, and in one example named, would have been only one sixth of the amount expended.

Prof. E. W. Claypole contributes an article on the world's supply of tin, that indicates a surprising amount of exact knowledge on this subject. Of the American mines only those of the Black Hills are noticed, and in respect to which it is claimed that the yield is about the same as at present in Cornwall, about two per cent., and at this some of the poorer ores must be excluded. The main part, or the one of most interest in the article, is the following table showing the sources of tin in all countries where the product enters into the world's supply:

Cornwall (1882)	9,000	tons of metal
Saxony (1880)	170	"
Italy (1880)	16	"
Russia (1879)	2	"
Japan (1875)	7	"
Penang and Singapore (1882)	15,942	"
Penang and Singapore (1887)	18,515	"
Penang and Singapore (1888)	25,594	"
Banca and Billiton (1882) ?	8,550	"
Victoria (1880)	103	"
New South Wales (1882)	6,500	"
Queensland (1881)	63,000	"
Queensland (1882)	16,380	"
Tasmania (1881)	3,500	tons of cassiterite

Following this table are the following remarks:

"Though the old mines of Cornwall, Saxony and other places will continue to yield a probably diminishing quantity for many years, and though the known deposits in North America may in future be utilized, yet it is to the southeast that the world must look for the present supply of its ever-increasing demand for tin. It is not likely that the rapid increase in output will be maintained. The stream-tin will become more difficult to work as the accessible parts are exhausted. But the steady following downward of lodes that contain cassiterite can scarcely fail to yield returns that must enable these countries to control the price of tin for many years, and probably reduce it."

A very suggestive article, of a speculative kind, is that of Prof. Perrin's on the "Altruistic Effects of Electric Power," in which he unnecessarily, as we think, introduces or refers to some of Ruskin's dreams. The essence of the article, is the social and economical effects of the subdivision of power, so that a workman can have power on his own premises and be his own master, the revenue of the factory system. Such propositions apply to only a very narrow fringe of our manufactures, and it certainly indicates a misunderstanding of the subject to claim that motive power is a powerful cause of the centralization of manufactures; or that the division and distribution of motive power would much influence the causes that have produced the factory system.

In old world cities like Birmingham in England, and Geneva in Switzerland, where subdivided special industries exist, the distribution of motive power to workmen may be practicable and desirable; but in both of these cities there is going on, rapidly too, a centralization of these industries that Ruskin's philosophy will not affect so much as the color of the paint on the buildings.

We would like to hear what Mr. Ruskin's opinions would be after visiting and comparing the two great watch-making centres, Waltham and Geneva, extreme opposite types of the factory and home systems.

How to Make Inventions.

Messrs. D. Van Nostrand & Co., New York, send a copy of the above-named work by Mr. Edward B. Thompson. It is, as might be supposed, a singular work. The title, to our mind, would be much improved by omission of the first three terms, because no one can instruct as to "how" inventions shall be made. Invention comes from suggestion and not from instruction, but the author has done all that is possible, perhaps, in the work he had in hand.

The main thing, or element we may say, in invention, is the discovery and understanding of "public wants," that is, wants of wide use, we mean invention for commercial objects, and that means nearly all inventions of our day. In this respect the author has supplied much material of the suggestive kind, and has laid down premises of various kinds, especially of a chemical and electrical nature, that will have much value.

It is a relief too, to see a book on the subject other than a contribution to cupidity and factitious methods, a good feature assured by the standing of the firm from whom the book emanates. The vast amount of technical information it contains, stated in a didactical way, will impress the memory a great deal more than when presented in the way of a treatise, and in this rests the chief merit of the book. It is not so much because of the number of facts presented, but the manner of their presentation, and the cultivation of a "logical method" thus induced, which seems to be the main aim of the author.

The book contains 160 8vo. pages, and costs $1.00.

Zanthon.

THIS work, by James Doran, published by the Bancroft Company, San Francisco, is what may be called a "political allegory."

The author has daringly disregarded the interest that attaches to localities, and, as it were, suspended his story in mid-air, thereby foregoing a powerful aid to popularity, which otherwise the book would enjoy for one class of readers, the most numerous, perhaps.

It seems to us, as before remarked, the story is to lead up to philosophic conclusions contained in half a dozen of the last of its 539 pages, but while contributary in this way, the story is, in the abstract, one of much interest, dealing with almost unknown circumstances in a Country, which of all others we should know the most—Ireland.

It was here that the wrongs of feudalic society culminated through a train of contributing causes that have long formed the theme of essay and argument.

It has been a conjunction of causes, each of which is separately denounced in a degree measured by the result. "Zanthon" will add a new light—a great deal of light, on various social relations that existed in Ireland previous to and during the famine which destroyed nearly half of the population of a country surrounded by the commerce of Europe, geographically a center of the world's activity, a kindly climate and fertile soil, it has been the paradox of our age, but now happily reaching promise of solution and reform, or indeed having in great degree arrived thereat.

At the risk of being officious, we think the learned author is able at this time to contribute a great deal to the cause of Ireland by a historical treatise reaching back fifty years and coming down to the present time, not forgetting the splendid capacities shown in many of Ireland's modern industries, her manufactures at Belfast and Dublin, the marvelous community at Bessbrook, near Newry, where no policemen are required in a population of three thousand people. It would be a fitting corollary to Zanthon.

Patent Decisions.

Appeal from examiners in chief, Weston *vs.* Richardson. Commissioners' Decision, Oct. 17th, 1891:

"In an interference where neither party "establishes a perfectly clear case, on evi- "dence, the presumption is in favor of a "party having a patent, as against one who "has not, and the latter, in order to prevail, "needs to establish his case by proofs which "do not admit of a reasonable doubt."

An array of United States Court decisions are given in this case, and the rule is clear in so far as principle, but there remains the flexible phrase of "reasonable doubt." "Doubts" relate to the impressions and conceptions of the Examiners-in-Chief, also the Commissioner, so the decision can not be construed as meaning only the bulk, directness, or even the nature of testimony. There is, perhaps, no branch of patent procedure in which opinions or convictions arise so spontaneously as in interference cases, because they always command interest and attention from the officers in charge, who are anxious to know the facts and study them.

The inadmissibility of any inflexible rules as to evidence in interference cases is shown by a decision of the Commissioner on Oct. 10th, only three days before the one above noted, in which it is held that:

"The question of priority of invention is determined by a fair preponderance of evidence, and doubts raised as to accuracy of witnesses upon certain minor points are not sufficient to overcome it."

TWO YEARS' PRIOR USE.

The law in respect to prior use is commonly construed too rigidly. In a late decision of the United States Circuit Court, Southern District of New York, Sept. 4th, 1891, Judge Wheeler laid down the following in his decision affirming the validity of the Knibb's patent on relief valves for fire engines:

"An inventor using due diligence by experiments towards perfecting his invention, and making application for a patent two years after its completion, will not be deprived of his right to a patent for it because of the construction and sale of a form of it by another, without his knowledge, during the time of experiments and before its completion, although more than two years before his application."

This is, no doubt, within the spirit and intent of the law, and will prevail in most cases, but seems in conflict with a decision of the Commissioner on Oct. 28th, 1891, in which he held:

"The invalidating two years' public use of the statute does not require the knowledge, allowance, or consent of the inventor."

Patents are not often debarred by prior use, in fact there are few cases where an inventor, by his own act sanctions or permits such use unless it be in the way of experiment and to determine endurance.

In some cases, two years of use is not too much to determine endurance, and in very many cases a year is required.

The Commissioner of Patents, in his late report, urges with all the force that language can give, an extension of the room allotted to his Bureau, and there seems no reason why all required room is not provided. He says that during six years past the Patent Office has paid into the National Treasury more than a million of dollars over expenditure of all kinds, and if there was no other reason, this is quite enough to warrant the provision of adequate room for the Bureau. We will, however, suggest that the model museum might be used, and the models, except a very few, cremated. The whole idea of models is provincial, and can have no object except to supplant a want of technical knowledge on the part of examiners, that need not apply to our day. Formerly drawings had to conform to models, and as models rarely conformed to actual machines, the result was that the drawings were, in many cases, caricatures, and in all cases bad, under the model system, which, happily, was discontinued a dozen years ago in this country.

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HARBORS ON THE PACIFIC COAST.

OTTO VON GELDERN, C. E.

The importance of a country depends upon its commerce, and the facilities afforded towards its successful operation. The principal highway of the world is the sea, and next in order are the communications provided to reach it from the interior of continents. Waterways become the essential feature for the commercial traffic of nations; the further inland they reach, and the nearer the producer is brought in direct contact with the ocean and the marts of the world, the more prosperous will that country become. It is imperative, therefore, that before a community can lay claim to any consideration, its sea coast must be made accessible to afford proper shelter and accommodation to the ocean carriers and their freight.

These are not opinions, but facts; facts that require no demonstration whatever. Nothing that man can devise is able to compete with the water-ways provided by nature; their inestimable value may be artificially suppressed by an antagonistic power, but the result of such suppression is certain to be a check to commerce and prosperity.

In our intercourse with the rest of the world, the harbors become our country's doors; if these entrances are not ample, or if they fail to give the requisite degree of safety, that fault must be remedied as far as it lies within the powers of human ingenuity to accomplish. Every effort should be made in that direction: to use the door where nature has provided it, to improve it where every attending circumstance necessitates an improvement, and, finally, to protect that door by providing defenses, so that we may bar the entrance to unfriendly intrusion.

Any policy of a government to neglect the importance of its coast line, its harbors and rivers, is suicidal; one to withhold their rational development and defense is criminal and a violation of the rights of the people.

The purpose of this article is to consider briefly the physical conditions of coast entrances in general; to glance at the history of harbor improvements on the Pacific Coast, and to bring before the reader the extent and cost of the engineering correctives that have been applied to resist natural difficulties, wrought by forces that are constantly at work to remodel the seaboard. These forces are tremendous and never to be "overcome"; only by means of the most intelligent strategy are we enabled to gain a point in our favor.

This field of engineering is not alone one of the most interesting, but will ultimately become one of the most important, for upon it will depend the commercial prominence of the whole coast.

Mr. Geo. W. Dickie's valuable pamphlet, published recently, on the "Commerce of San Francisco," points out that we must revive and stimulate our trade with the outside world, and suggests a plan by which we may attempt to found our commercial independence. The interest with which this pamphlet was received and discussed has shown that the topic is a timely one, and that we have come to realize the value of the merchant ship; and this has led me to take up a subject intimately connected therewith—the accessibility of the Coast to ships.

The Pacific Coast of the United States extends from latitude 32° 32′; longitude, 117° 08′ (the Mexican boundary), to the Straits of San Juan de Fuca, in latitude 48° 23′, longitude 124° 44′, its direction being approximately northwest. In this distance of 1,130 miles it presents an irregular line, in which there are a number of projecting points, bights, inlets and harbors, that make up the characteristics of our ocean border. From San Diego to Point Conception, 225 miles, the trend has a general direction 50° west of the true meridian, defining with a radius of 200 miles the great bight of the southern coast, guarded by the Santa Barbara Islands from the seaward. This reach contains the harbors of San Diego and Wilmington, and a number of open roadsteads, as San Pedro, Santa Monica and Santa Barbara. From Point Conception to Cape Mendocino, the coast runs 30° west of north, 425 miles, and about half way between the two points lies the most important and the most advantageous harbor on the Pacific Coast, the great Bay of San Francisco. South of it there are several open ports of more or less importance; Port Harford, Esteros Bay, San Simeon Bay, and the Bay of Monterey, while immediately north of the Golden Gate, under the shelter of Point Reyes lies Drake's Bay, and above the Point, Bodega Bay. From Cape Mendocino to Cape Flattery, 480 miles, the trend is nearly true north, embracing the coasts of Northern California, Oregon and Washington. Humboldt Bay, Coos Bay, Yaquina Bay, Tillamook Harbor, Shoalwater Bay, and Gray's Harbor; the mouth of the great Columbia, of the Coquille, Umpquah and Siuslaw Rivers are protected inlets, more or less accessible from the ocean, while the principal roadsteads resorted to for shelter are Crescent City Harbor and Port Orford.

A feature of the Pacific Coast is that deep water exists comparatively close to the shore line. Depths of 100 fathoms are found from one to forty miles off shore; south of San Francisco this feature is more marked than on the northern reaches, for from Point Sur to San Diego this curve averages less than five miles from the land.

All entrances on the Coast are barred by a submarine wall of sand, somewhat in the shape of a horse shoe, with steep slopes directly to seaward, and gentler falls toward the inlet, excepting on the flanks of the cordon, where the exterior slopes are usually more gradual than those of the interior. Over this bar there are generally several well-defined channels, kept open by the scouring capacity of certain currents. In some instances these channels are permanent and hold their alignment, while in others they are constantly shifting, often retaining, however, two characteristic forks or branches that lead over the main barrier at two extreme points.

Of recent years the subject of ocean bars, that is, the cause of their formation and shape, and their yield to controllable physical forces from within, has received considerable attention, and has led to an earnest investigation and serious study. The complexity of causes and effects, however, has not been favorable to the discovery of laws reducible to formulæ, that will express results in given cases under given conditions. The principal progress has been almost entirely made by empirical deductions, and, as usual in such cases, the failures in attempted corrective works have been of fully as much, if not of greater value to the profession than the successes.

On the Atlantic Coast the researches of Professor Lewis M. Haupt have led to the origination of certain principles, that, although known, were not regarded in the full light of their importance. The great merit of his labor lies in his fundamental theory of the motion of the flood component, the development of this current on the line of the Coast and the effect upon the shape and extent of the bars. This movement is the direct cause of the littoral drift, and the application of his theory extends to a successful restraint of the aggressive forces that approach from the direction of the flood component. Mr. Haupt's labors have been confined, as far as I know, to conditions existing on the Atlantic border, but the general principles must necessarily be applicable to all coast lines before the fundamental law becomes fully established.

On the Pacific Coast our harbors have been the subject of very intelligent and long continued study by Colonel George H. Mendell, of the United States Engineers, who has supervised and directed all the projected improvements with the first inauguration of such work here.

Professor George Davidson, of the Coast Survey, is another authority. He has spent forty years in collecting and arranging data of our hydrography, which has been recently published in his compendious *Coast Pilot*, a work of great detail, which, in addition to the aid furnished by the Coast Survey charts, enables one to examine every nook and cranny of the Coast from Mexico to British Columbia, including the extensive inland waters of Puget Sound.

The force that builds bars is the wave action of the sea, approaching the land from a distant part of the ocean, and with it the littoral flood current, which gives plasticity to the harbor entrance and determines the shape and condition of its outlying spits. Other physical elements, such as the force and direction of the wind, may, to some extent, influence the littoral drift movement, but they, in themselves, are not responsible for the mould and character of the bar. The predominating power lies in the direction and quantity of the wave action ; it has been observed that there is frequently an opposition in the two directions of prevailing wind and littoral movement. Professor Haupt seeks the explanation in the shape of the coast line, and in this he deserves the acknowledgment of being the first to discover an apparent connection between it and the direction of the flood.

Excluding the harbor of San Francisco, which has two permanent shores, our entrances are formed by long sand spits extending along the coast line and reaching towards a projecting headland. Between the end of the spit and the head opposite is the entrance to the harbor, or, more properly, the lagoon, which lies back of the sands described. Instances of this formation are the harbors of San Diego, Wilmington, Coos Bay, and Shoalwater Bay, while Humboldt Bay is enclosed by two sand spits approaching from opposite directions.

The tendency of the wave action of the ocean is to *close* and *obliterate* an indentation or recess in the shore line, the littoral current being the agent that directs the course in which the sands are built up. It is the tidal influence that *opposes* this destroyer; the amplitude of the tides and the area of the tidal basin being the principal factors that constitute the *conserving force* of the harbor, which keeps open an outlet and makes the inner basin accessible from the ocean. The watershed from the land is inconsiderable when compared with the semi-daily recurring tidal drainage, and adds little to the efforts of our harbors to keep free. This is more particularly the case in the southern harbors, but even on the northern coast the land drainage is of secondary importance, in so much as the tide remains in every case the main conserving element. Colonel Mendell has stated that the great Columbia, with a flood discharge of a million cubic feet per second, might not be able to maintain throughout the year the entrance depth required for deep sea vessels.*

It is evident that the product of tidal rise and area of basin; *i. e.* the tidal prism, and the time of its discharge through a given area of the gorge, will determine the velocity of the outflowing current, whose scouring effect is brought to act upon the sandy barrier thrown up from without, and that these elements constitute the gauge or measure of the available channels.

In addition to this scour there is to be considered the greater energy of the daily intruding flood, whose importance has been only too often overlooked. Its scouring effect at the throat, or gorge, when the waters are forced through the small aperture into the harbor, is of a greater magnitude than the more gradual and unresisted outflow of the ebb, and it becomes responsible for the usual inner bar containing the debris gouged from deep holes at the mouth of the inlet. In the antagonism between the flood action and the ebb, the sands are ordinarily piled up from a direction at right angles to the principal outlet, while the ebb makes an effort to escape, not into the teeth of the attacking force, but at the point of least resistance, on a line normal to, or away from the forces developed by the flood.

Thus, at the mouth of the Columbia River, the outflow sought its way over the bar in two channels normal to the main strait, and

*See Transactions of the Technical Society of the Pacific Coast, Vol. III, No. 1, page 5.

endeavored to make the most advantageous exit under existing conditions, that is, removed from the assault of the prevailing drift; while at San Diego, where the flood action is from the southward and towards the projection of Point Loma, there is but one main channel crowded closely to the headland, which turns away from the direction of the flood, and finds its outlet over the bar as soon as it has cleared the extremity of the Point. By this crowding of a channel are created two characteristic shores of the inlet, one whose tendency is to grow under the management of the flood, while the other is tending to erode under the influence of the receding ebb, which is pushed and crowded over against that side. It may be necessary, in some cases, to protect the banks suffering from excessive erosion, but there is no need to add to the stability of a head that nature has built up and endeavors constantly to maintain.

An equilibrium is finally established, and thereupon those harbors will retain their mould in which the contending forces are evenly balanced, and neither is made, at any time, to preponderate over the other. But any change in the intensity of the resultants is sure to change the navigable condition of the entrance.

It is the duty of the engineer when planning an improvement, to study and weigh carefully the physical factors that enter into his particular case; to observe the littoral movements and direction of the flood action, and to measure the elements of the conserving force, so as to determine in what manner the latter may be encouraged to produce the best effect upon its bar-building antagonist; and it goes without saying, that every rational improvement of ocean bars must be based upon a sound knowledge of the natural forces that cause them. We know that experimental works carried on without a thorough investigation of the field, have not only resulted in wasting large amounts of money, but have been the cause of injuring, instead of bettering existing conditions. The problem is always an intricate one, and although we may be thoroughly acquainted with its general principles, there are many factors due to local causes that only too often elude our observation.

The profession is certainly indebted to Mr. Haupt, to whom I have referred, for agitating and creating discussions of such vital importance. He suggests remedial measures in accordance with these theories, that are original with him as applied to meet his conditions. Without going into any details, the main points to be observed in an improvement seem to be: 1st. That the flood be allowed to enter freely, in order to insure a full tidal prism for the work of the ebb. 2d. To place a barrier against the material brought by the flood action or littoral drift. 3d. To create a harmonious action of the ebb currents, and to concentrate their energy upon the weakest point of the bar.

The means employed to gain these ends are so-called jetties—spurs or dikes built of stone, riprap or concrete blocks; or of piling combined with stone; or of brush mattresses weighted with a heavy material, in which the drifting sand is made use of for creating a wall.

It has been a question of considerable discussion whether these jetties should be built as single structures, or as double or twin jetties; likewise has their position given rise to numerous arguments in scientific circles. The choice will necessarily depend upon a given case, but from the principles involved the conclusion is forced upon us, that for tidal harbors, the single detached jetty affords every advantage over the double system in point of economy and effect. If it can be so made and placed as to exclude the littoral drift, admit the flood and direct the ebb over the most vulnerable part of the bar, we shall have combined in one structure all the requirements of a corrective work.

It is self-evident that a barrier placed against the destructive force of the wave is of the utmost importance, but it may not always be practicable to construct it in such a position as to afford the maximum degree of shelter on an exposed coast. Material removed from a bar must find lodgment exteriorly, and if not carried to one side it will create another beyond the one displaced. It is here that the littoral current becomes most valuable, as it can be made use of for transporting the debris that is washed over the bar. At the mouth of the Columbia River, where the littoral drift is to the northwestward, close along shore, a low-tide stone jetty is building along the inner line of Clatsop Spit, one of the flanks of the main channel. It was so aligned as to concentrate the ebb flow over the middle of the main outer cordon. Two and three fourths miles of a projected line of four and one half miles are now in place, and this has produced a marked effect on the bar. It remains to be seen, however, whether this improvement is of a permanent character. If the littoral current will take care of the material brought over into the sea, the chances are favorable that better depths will remain; but if it prove otherwise, then conditions will arise beyond the end of the jetty, similar to those that existed before the greater energy was imparted to the outflow. If unchecked, the tremendous building forces will continue to reconstruct and remodel the bar that the engineer is endeavoring to remove.

On the southern coast of California, where a group of outlying islands acts as a barrier, we have an instance of the importance of a breakwater to the great ocean swell. Harbor improvements are possible on that part of the Coast, and have been successfully carried out, that would have been impracticable where such natural protection does not exist. These islands reduce the aggressive force from without, and make a conserving element of less magnitude from within do better duty than it would under conditions of greater exposure to the sea.

It may here be mentioned that all mechanical means to deepen sand bars on the sea coast, such as dredging or blasting, carry with them the most ephemeral results, and are, indeed, a useless expenditure of time and money.

The tides upon which our harbor entrances depend vary with the phase and position of the moon. At the syzygies we have great tides with strong currents, while at the quarters they become least and the currents weak. At San Diego the average rise and fall is four feet, the greater run-outs nearly eight feet, while the smallest differences are barely one foot. At San Francisco the mean rise is three and a half feet, the extremes seven and a half feet and the weak tides about one foot. At the mouth of the Columbia the tidal action increases to about six, ten, and one and a half feet, respectively. The smallest rises are practically "stands," when the elevation within a period of about five hours differs less than a foot. Of such stands there may be seven during a lunation.

A peculiar characteristic of our tides is what is known as their diurnal inequality, which consists of a considerable difference between the two floods and the two ebbs of the same day. After the lower low water of the day the tide rises to the lesser high water; then follows the small run-out, which, as we have seen, may only amount to one foot; this is succeeded by the higher high water of the twenty-four hours, after which the tide falls again to the lowest ebb stage. These inequalities are more pronounced, or less apparent, as the position of the moon varies, and may entirely disappear at the neaps, but they are the rule. As the navigability of bar channels depends upon the greater tides, this peculiar feature of a double rise to one long and vigorous outflow is certainly a most fortunate arrangement for the coast.

Having outlined certain conditions necessary to comprehend the situation, I will discuss briefly our main harbors, and what has thus far been done in the matter of their improvement, and how much these improvements have cost.

The harbor work on the Pacific Coast has been in the hands of the United States engineer officers, who have devised, superintended, and carried out whatever improvements were favored by the National Government, and they have managed and disbursed the funds made available by Congress for that purpose. The river and harbor appropriations for this coast aggregate something like $10,000,000. Of this sum California has received about $4,000,000, and Oregon $6,000,000. Nearly half of these amounts have been spent in clearing the rivers, and a little over $5,500,000 in the improvement of our coast harbors. It redounds to the credit of the corps of engineers that this large sum has been carefully and honestly administered.

One of the main obstacles in the way of carrying out work of this character, is the desultory way in which the appropriations for it are usually made. I do not know of a case in which there were ever funds sufficient to prosecute it properly. When we consider that one of the main points of success in this battle with nature lies in the rapidity with which the defensive system can be completed as designed, we perceive at once the difficulty of attaining anticipated results.

I have already pointed out that what is known of this subject has been solely learned by experience and by empirical deductions. Data have been gathered from nearly every existing corrective work, and the careful study of these data, together with a closer inquiry into attending physical phenomena, have led to the information that we now possess. The science is a growing one, developed by the engineer, and in this the *civil* engineer, as *well* as his brother of the army, has performed his full share and should be entitled to all due credit. Discussions of the subject among engineers are of the greatest importance, and wherever harbor work has been attempted, and has been either *success* or *failure*, the result should be made known and freely debated. It is unfortunate that these discussions are often made a personal matter between the civil engineer and the engineer of the army. Recently this topic has been frequently brought before the public, and as the interest therein advances, it will continue to be the theme of many a warm argument, for the matter is of too great an importance to our commonwealth to pass it by without giving it attention. Our prominent engineering magazines have been full of the subject for some time, but in nearly every instance has the matter been made a personal one between the two factions.

A violent attack like Mr. Wisner's, published in the *Engineering Magazine*, (January, 1892) should have received the most serious attention from the government engineers. The reply from Colonel King in the following number of the same serial, which attempts to throw ridicule upon the whole affair by the display of some clever witticism, is not at all dignified, and neither befits the man nor the very grave case. An earnest subject of this character does not admit of jocund raillery nor of manifestations of anger. When Lieutenant O. M. Carter, of the United States Engineers, in a recent discussion before the American Society of Civil Engineers, referred to Professor Haupt as "probably more familiar with sweeping a room than with harbor work," he gave the best evidence that he had lost his temper, and it is well known that a man who begins to indulge in personalities carries no weight with his argument, and has already lost it.

(*To be Continued.*)

OVER-PRODUCTION AND EIGHT HOURS.

The late report of the New York Bureau of Labor Statistics is construed by some of the foreign journals that have examined it, as an argument in favor of eight hours working time instead of ten. If so, it will be a powerful factor in promoting that aim by those who are now contending for shorter hours, but the argument presented, if argument it can be called, is "over-production." This term, thing, or whatever it may be called, of over-production, is in respect to nearly all kinds of business, an economical myth.

The history of our manufactures, and also of the domestic economy of any country will show that the consumption of useful commodities more than keeps pace with a reduction in their price. Of all things that can be named, woolen cloth has been "over-produced" in this country. The market has been glutted for years and the output disposed of at "jobbers' sales," which is nearly the same thing as an auction. Now, does any one suppose that woolen cloth has been over-produced? All the stored cloth in the United States could be sold and made into clothes in a month if the price were low enough, and if we could not consume it the Chinese would. Woolen cloth is a luxury there, and eagerly desired, but cannot be afforded. Cotton padded garments take its place.

What is true of this commodity is true of nearly all useful things, from pins and lucifer matches up to carriages and houses.

The "over-production" people do not take into account that there are very few industries where a change of working time will not alter the cost of manufactured commodities in the same degree, because not only will wages, if kept at the same rate, be advanced twenty per cent. by shortening the working day one fifth, but all other charges, except, perhaps, fuel, will also be advanced in cost the same as wages.

A result of this, and one that we have every right to assume, is that consumption would fall off in an equal or greater proportion than prices are raised, so that "over-production," if there be such a thing, will be just the same after shortening working hours that it was before.

The trust or combination method of limiting production is quite a different matter from shortening the hours of labor. It is withholding from markets by schemes of a commercial nature and extent that would not, even in the smallest degree, apply to a general shortening of the hours of labor.

We are not opposing the eight hour movement, on the contrary are in favor of it, but want to see the increment of labor cost taken from the price of material in most industries, and, in others, from the profits of sale, or from middlemen. The replies received by the New York Labor Bureau in answer to an inquiry sent out to labor organizations, in nearly all cases were favorable to an eight hour rule, and whenever reasons were given the "over-production" and "more work for more men theory" was that reason. This we esteem a fallacy, and the weak point in their position.

That the increment of value, due to machine processes and the thousand ways of augmenting output, does not go into wages, must be obvious enough to workmen, and, if they will look a little deeper and see where this increment of value does go, they will find a better argument in favor of shorter hours than the assumption of any "over-production" of useful commodities.

If the labor organizations will appoint committees to investigate and keep a record of what it costs to "sell" the commodities that workmen consume, there will be found in this one of the principal impediments to the eight hour day's work. They will find the sewing machines their wives buy for sixty dollars have been furnished by a manufacturer for fifteen dollars; their life insurance policies for which they pay twenty-five dollars a year, worth only ten; their best suit of clothes, for which a tailor demands sixty dollars, they will find is, in fact, only worth twenty, and so on through large things and small, down to the pocket knives for a dollar, that "enter the trade" at thirty cents.

It is not "over-production" that is in the way. It is, indeed, almost the opposite, it is the "non-producer," who by consummate skill has increased values and smothered consumption. Almost anyone, in talking of our industries will say: "It is not in the production of commodities where the greatest skill is required, it is in selling them," and this is true of nearly all things that pass through the routine of mercantile trade, and not true of any kind of product that passes from the producer direct to the consumer. It is true of nearly all a workman has to buy, including fuel, clothing, school books, house-furnishing goods, medicines, and the hundred little things that are consumed in a family, and of which he buys just as little as possible. To pay these prices the workman has to work ten hours a day, and when a manufacturer's product goes through this routine of agencies, commissions, and leechings of one kind and another, he requires ten hours' work to make a living profit. He does not complain of "over-production," but of under-buying.

A PREACHER'S VIEW OF CIVIL ENGINEERING WORKS.

The following address is reprinted from the *Railway Review.* It was delivered before the Western Society of Civil Engineers by the Rev. Mr. Conrad Haney. It is remarkable in many ways, especially as relates to the buried past of Central America. The wit, eloquence, and erudition shown in the address places it above any effort of the kind that can be referred to.

Mr. Haney said:

"It is needless for me to say, gentlemen, that I am somewhat embarrassed in this presence, for the civil engineer is altogether a mystery to the average mortal. We are well acquainted with your works as they rise in the massive edifices, or cleave their way across the continents and over mountains and seas, and those achievements that are the very highest triumphs of the advanced civilization of the present day. But you yourselves, studying in offices or observing upon the fields where sooner or later you expect to conquer, laying plans in general to circumvent nature, and turn the world quite upside down, seem to court retirement from the public gaze. When therefore I suddenly come face to face with more civil engineers than I have ever thought of before, although you look very much like regulation mortals and appear to have orthodox human appetites, it is only natural that the timidity of the ministry, which is also a hereditary trait in my family, should quite overmaster me. I am somewhat encouraged by the fact, however, that I am something of an engineer myself; for who have built more bridges than the clergy in their attempt to make transportation into the world beyond as safe and easy as unfortunately it is rapid? Show me if you can drawings of an elevated road that can compare with the Methodist highway; who have ever devised a tunnel, that metaphorically speaking, will not hide its diminished ray before the shaft that the Unitarians and Universalists have driven straight through the mountains of theology that other generations have been forced to climb? Let me ask you in all candor, can the Hennipin canal scheme compare with the Baptist waterway? (Great laughter.) Or our new drainage commissioners find such an outlet for the sewage of our great city as the Salvation Army? Well, now that I bethink myself, gentlemen, I feel quite at home in your midst tonight, and I am inclined to take all of you into full fellowship immediately. Having thus fixed my position in the profession in a way that is entirely satisfactory to myself at least, permit me to say that the real meaning of our work first dawned upon me some three years ago, in the Republic of Honduras, as I rode upon the overland express of the Honduras and Interoceanic Railroad. Will you permit me to describe this flyer?

First of all was a wheezy, little, old engine, at the throttle of which stood a driver—we engineers never call him anything else—

as black as Erebus, but the very soul of good humor. Two natives sat in front, where the pilot had once been, with a box of sand between them, which they applied to the track as occasion required. Back of the engine were two of the most unutterably dilapidated flat cars that eyes of mortal ever saw; while the second-class passenger coach, with its roof off, left its passengers exposed to the broiling sun. The train concluded with a first-class coach a century old. A long, wooden bench stretched from one end to the other of the car on the larboard side; the starboard side had been ornamented with a similar device at the time when the 'morning stars sang together,' but now it lay broken among the rubbish and cigars stumps and boxes that some generous Honduras travelers had strewn around. There was not a brake on the entire train, nor was there a sign that there had ever been one, and I doffed my hat before those hoary old ruins with the reverential awe that all time-honored relics inspire in me.

The conductor of this rare aggregation of antiquities was a tall, sunburned specimen of humanity with linen clothes and straw hat, who hailed from Chicago, as genial and honest and good natured a man as ever pulled a bell-cord or punched a ticket. He looked and behaved as though he were born to the trade, and fitted into the hot sun and waving palms of the tropics as nicely as though the energy and stir of Chicago had never warred about him. After an amount of whistling that left only steam enough for an asthmatic wheeze, the little engine pulled out of the station. Soon we stopped to fill up the sand box; another move, and we stopped for water; then we stopped while the conductor hunted up a carpenter, and gave him time to repair the first-class coach; then we stopped for wood; then we stopped to give me an opportunity to take some photographs; then we stopped for dinner; then we stopped while the conductor conducted a drunken passenger to his home, and had a little chat with his family; then we stopped to take a drink; then to put the train on the track; then we stopped for the fun of it. There were more stops altogether than on any grand organ I ever saw. We were allowed to ramble through the fields or in the woods as the case might be, and then the conductor escorted us all back to the palace car. Talk about your accommodation trains! But the road-bed! Oh, shades of Cooley and Eads, and all the rest of you. That was what gave me my passion for civil engineering. It danced up and down like a Norman colt on a frosty morning; it dodged in and out in a way that made me dizzy to contemplate, and would fill with astonishment the right honorable first vice-president of this society. But like the Cunard Line, the Interoceanic has never lost a man, and with unflinching faith in destiny I held on while that old caboose sped by bank and jungle, over 37 miles of jagged iron. Talk about the blue laws, and witch-burning, and the inquisition! I want to say to you, gentlemen, that the civil engineer that could evolve a road like that, that would lacerate a man's body and destroy his piety, that would set his head and stomach to aching, and make him heart-sick, and home-sick, and sea-sick, is worthy the place that the most lurid theology has ever painted. It was months before I could face a civil engineer without feeling a great deal of sympathy for myself.

Two weeks after that I stood gazing upon such a scene as I have never faced before. Around me towered huge stone monoliths in exquisite design. On my right, down to the valley of the Rio Coco, there were rows of pyramids that seemed companions to those vast monuments on the shores of the Nile. All around there were shattered walls, running in every direction through the dismal solitudes of the tropical forest, and for miles the whole country was covered with broken carvings and pieces of figures, and shattered remains of former magnificence. There was no human habitation near and no evidence that man had made his dwelling in that neglected ruin for centuries. Perhaps, on the sight of the ruins I was now gazing on there had been once a splendid empire in the days before Pharaoh worshipped Isis, or Abraham left Ur. There are records of the growth and power and decay of Babylon; there are stories of the time when the children of Israel were led out of the wilderness, and Egypt and Assyria were vocal with the voice of priest and king; and yet there, beneath the waving palms, as voiceless as the grave, as mysterious as death itself, lay the mangled ruins of an empire whose very name had perished from the earth. I clambered to the summit of that mighty pyramid and looked away across the valley in which that mysterious antiquity was buried. There were the mountains, giant upon giant, billow upon billow, the very petrification of action. It seemed as if the earth had been shaken by volcanic disturbances until the land was a monster caldron, rocking and roaring and heaving until its seething billows tossed their jagged crests into the very heavens; then, in an instant, a cold breath from the mouth of God had turned them into granite as they were, and left them yawning in their rigid death, until kindly nature with a pitying hand had painted them red and white and green and crimson, and melted all the bald sublimity of scenery into a symphony of color. This, all this, was God's, except the single human thought that had defied the centuries. Science had perished, literature was buried; art was obliterated; religion itself had faded even from tradition; earthquake and tempest and fire and storm, all the whirlwinds of a severe warfare—and no one knows what blasts—have swept over that empire, and century after century have buried it deeper and deeper yet in the dust of oblivion; and yet, despite it all, to-day, akin to eternity, from out it all arose the walls, the aqueducts, and the monstrous old pyramids, the eternal thought of the civil engineer of the olden times.

Long centuries before the red man chased the bison over the boundless prairies of this continent, long centuries before this country was even thought of by Europeans, there lived between these oceans innumerable people very far advanced in all that goes to make a civilization. The altar fires of a splendid religion shone over the country from the Rockies to the Alleghanies; there the busy multitude wrought and toiled, where the rivers bear commerce to the lakes and the gulfs, and garrisons floated their banners from high towers, or armies marched to meet and conquer from north to south. How do I know this? From religion? It has perished. From art? It has perished. From history? It has perished. From tradition? The tradition has perished; everything has perished, and the knowledge of the nation itself would have perished but for the mounds, the limitless earthworks, the huge, old mounds, the embodiment of the thought of the ancient civil engineer. (Applause.) What light do tiresome lists of unpronounceable king names shed upon the grandeur and splendor of ancient Egypt? You must stand and read the thought of the engineer as it towers in the first great pyramid if you would understand her grandeur. What do we know with certainty of ancient Babylon until we turn our backs upon that vague mass of tradition, and read the thought of the civil engineer by the banks of the Euphrates. And last of all, how could we substantiate the truth of our sublime Old Testament, had not the civil engineer of the olden time told the story in earth and stone, to rise up in the 19th century with a grand amen to the word of God?

The orator writes his thoughts upon human hearts; the philosopher engraves his ideas in human lives; the artist places his being upon canvas, and the scientist and the poet inscribe their thoughts upon the written page; history is only pen and ink and paper, and tradition is nothing but human memory. But human hearts cease their beatings and human lives go out; the canvas moulders into decay and the books soon perish, but the stone and the iron and the ore and the steel that knead themselves together to mirror the mind of the civil engineer, they alone of all things mundane are eternal. You are building, not for today, nor for tomorrow; you are building forever.

I should be glad, did time permit, to speak of the magnificent achievements that you have made. Of the railroads, those links of steel that marry the oceans; of the colossal bridges whose massive weight you have raised upon foundations far below the river sands, of the wondrous shafts that you have driven through granite mountains or under streets and rivers; of the harbors and waterways—all these triumphs of your thinking are before me, until it almost seems as if you had harnessed boundless nature to do the work you are doing.

Sometimes, you know, we uninitiated are very likely to ascribe these monuments to the capital that is paid for the work that has been digged, or for the stones that have been heaped, and we fancy too, very frequently, that those who seem to have had charge of the mere mechanical details are worthy of the meed of praise. That which we see and feel so occupies our mind that we sometimes overlook the fact that the omnipotent forces are the unseen, silent ones. The earthquake and the whirlwind and the tempest and the fire are child's play beside the silent grandeur of gravitation, that all unseen makes unity out of the tangled splendor of a pulsing universe. No greater is hod-carrier, or contractor, or capitalist, as he stands in the presence of the civil engineer.

From the great pyramids of Egypt down to the Brooklyn Bridge, all magnificent, material monuments of all civilizations have been builded in the brain of a thoughtful man, unseen and sometimes unrewarded, long before common labor has brought them to the public view, in steel and oak and iron; and in the centuries to come, when another age is looking upon these works that you are building, the inquiry will not be, who builded, but who devised, and the honorable mention will be laid at the feet of the man whose thought has made these monuments a possibility.

BOATING IN SCANDINAVIA.*

It is a matter of surprise that those old Grecian philosophers, or humorists, which, has never been decided, did not define man as a boating animal. Except certain marvelous stories about squirrels crossing rivers on pieces of wood employing their tails as sails, man alone, among the dry-land tribes, ventures to sail over the water. The philosophy, which lies at the bottom, is of too abstruse a nature to be taken up here, and is dropped with the single suggestion that, so far as the Scandinavian Coasts, the danger is, no doubt, the main fascination of water journeying.

I have sailed in a five-ton boat with a Swedish gentleman, who was as familiar with those rocky fiords about the mouth of the Göta-elf, as a Bostonian is with the paths in the Common, and yet he was continually excited, his mind on a strain, and it was only in certain places when he would trust the tiller to the "styrman," while we went below to take some of the inevitable "punsch." I did not understand his anxiety and thought him nervous; no danger was apparent, to me at least, but I learned better.

The Scandinavian coast is, I am told, volcanic, and if volcanic means that the granite hills have been torn to shreds, and scattered along the coast, and far out to sea, the theory is, no doubt, correct. It is awful! No description can convey an idea of how ragged, frightful and irregular the coast is. For miles after leaving clear water to approach the main land you are among a maze of ragged rocks and crooked fiords. First you have 20 fathoms under the keel, and in 50 yards farther you are sailing over the top of jagged, broken, granite rocks, which come near enough to the surface to

*The present article, unpublished before, was written by the Editor of INDUSTRY in 1874.

make a black spot in a calm, or to show their position by the ripples in a wind. All is alike, one place the same as another, except to those old, weather-beaten fishermen (*fiskarne*), and even they, in a life time, can only learn a small part of the coast sufficiently well to sail in safety.

He, who has read the stories of the old "Vikings," can here see the circumstances which gave rise to their daring. There were no tools or skill to transform their granite into castles and forts. Wood, which was alone the material for houses, would not withstand the onslaught of their fierce enemies, and the result was that the old Scandinavians took to the water as a stag does at bay. There they were on equal footing with enemies. The awful aspect of nature, and the danger of their coast made it impossible for their injured enemies in Southern Europe to approach them. When the Rover (*Viking*) spread his sails and ran home across the German Ocean, he entered the rocky fiords, where he was to the world, at that time, just as though he had sailed into that "open polar sea."

The writer who had read and was interested in the old legends of the North, as explained before, caught the boating fever, and determined to sail out into the Rock Garden (Skärgord). The first thing was a boat. Now to a person accustomed to a trading community where competition rules, nothing seems easier than to go out and buy a boat, but not so in Sweden. There are thousands of boats, but as a Swedish friend explained, "no one has a boat except he has use for it," consequently boats were not for sale.

Boat builders there were, plenty of them, and I went to one to have a new boat built. I was received with a polite bow, and inquired if the boat builder had any boats on hand? He stared at the proposition. Next I inquired if he would make one. "Yes." When could he have it done? "He did not know." Could he have it done in two weeks? An emphatic stare, no answer. I saw that the mark had been overshot, and suggested a month. This elicited another stare, less emphatic. I inquired when he could have one ready? and he answered "he did not know." At this point he politely offered a cigar, and we sat down, like a Governor of New Amsterdam, to think. After thinking over the matter for some time he concluded that he already had more work than he could do that summer. I went home disgusted, and upon relating the matter to a friend he explained that the boat should have been ordered the "previous year."

I relate this to show the circumstances which exist where there is a want of competition. It was clear that I must either capture a boat by force of arms, or wait for some one to die. There were boats of ten to twenty tons for sale, but I wanted a small one which could be managed by one person, and that person, myself, who was by no means an experienced sailor of small boats.

Fortune smiled on me. Walking along the quay one day in Gothenburg, I saw a boat of about three tons, newly painted, and knew it was for sale, because no Swede ever painted a boat in any other case. The price was 200 rigsdallers, about $50, and not much more than would pay for the sails in America. The boat was at once bought, and the owner, the former one, went out into the river to show how the boat would sail, but not until he had secured the services of a second man to assist him in managing the sails. A brisk wind was blowing, and whatever other peculiarities the boat might possess, of one thing I was certain, that it would sail on its side; the boat was 18 feet long, 7 feet beam, and strong in every way.

Friends congratulated me on the acquisition of a safe boat, and all inquired "who was going to sail it for me." When I told them I was going alone, they laughed at me, and then seriously assured me that even if I understood sailing it was a madness to think of attempting to manage such a boat alone. I had seen too much of Sweden, however, to have much faith in these views. What one man does in America takes, generally, from three to five men in Sweden. Manly sports and rash adventure are not indulged in, and I went then, as I hope to again sometime, out into the Skärgord alone, and came back. How, will now be told.

The same evening, upon which the boat was purchased, after the wind had gone down a little I went on board, and, after various experiments, got the main sail set. The gib I thought would be too much to attempt, and that one sail would do for a first experiment. After various gyrations, which excited wonder on the shore, I found that the boat would not come about without the gib. An acquaintance with the principles of mechanics explained this to me. I let go the main sheet, and after much trouble got the jib set.

Then came the strangest cruise that had ever been seen in the Göta-elf. I went dodging about among the shipping, luckily missing them all. In tacking I did not manage the gib properly, and was generally driven astern, beam to the wind, and blown over until the lee gunwale was under water. I heard shouts from the shipping and from shore, but whether of derision or instruction, my ignorance of the language did not permit me to know.

Amid the excitement my mind wandered back to an ill-starred occasion when I once made an attempt to ride a bicycle. It was the same thing, except that instead of the danger of a few bruises, there was a certainty of being drowned if the boat capsized. There was half a ton of ballast beneath the floor, and the boat would have sank as quickly as a stone.

Matters improved, the river grew wider, by a mistake I held on to the gib too long in one case, when tacking, and found that it brought the boat around without trouble. That lesson was remembered. I began to gain confidence, and in an hour and a half had worked down the river far enough to meet the ocean swell, which was coming in. The river here was nearly two miles wide, and as it was growing late I determined to return, but not to return again among the shipping. The boat was left with an old sailor at a place called *Klippen*, and I returned on a little steamer to the city, where my friends were astonished to see me, supposing I was, of course, drowned.

That night, to a late hour, I spent in studying, so far as any data could be come at, the laws and principles that govern the action of sails and boats. My blood was up, the fever was on, and the success of the evening had rendered me bold. My friends were out for a few days at "Stenungsund," a bathing place 40 miles away, up a fiord, and to reach which there was a long, dangerous cruise in the Skärgord, before coming to the fiord. I had been twice over the track, once in a steamer, and once in a yacht, and determined to go there on the following day in my boat. For fear of being detained by force, this proposed rashness was not explained to anyone, and early next morning I took the steamer for Klippen ; with a hamper of provisions, bottles to hold water, some thick clothes, and by 10 o'clock had cast loose at Klippen and started.

I sailed out past an old castle or fort called "Elfsborg," and turned to the north among the granite islands, steering hither and thither to miss the rocks, and keeping my course as near as possible by the sun.

At 1 o'clock, when crossing a small bay, and when all was apparently going well, I was struck by a squall, or rather by a puff of wind, a phenomenon which is almost unknown outside this rocky coast.

Out at sea the wind is constant, or at least is in other places, but among these granite rocks is broken up into tortuous currents and whirlwinds, that seem to come from every corner, and in puffs of such strength as to capsize anything but a Swedish boat, and even these are only safe when managed by those who understand them. I was sailing along with a moderate breeze on the after quarter, when, all at once and without the slightest warning, I could see the wind strike the boat forward, she keeled over till the water came over the side, and, luckily for me, the sheet gave way letting the mainsail blow out, and thus saved the boat. I sprang to the sprit and lowered the sail, tried to bring the boat into the wind with the jib, but too late, I was on the rocks. The sea was not rough yet, and by taking down the sails and using the poles I got the boat off and worked around a point of the rocks so as to be blown into open water again. I then set the gib, the boat meanwhile tossing so as to throw the loose effects overboard or into the bottom, and felt relieved when the jib got control over the boat so that she could be headed to the wind. I steered across the fiord for a narrow opening on the other side. Covered with spray, my oars and other effects gone, and thoroughly frightened, I felt glad when the boat glided calmly up into a quiet nook among the rocks where the sea had no effect. I made fast, sat down to think, and came to the conclusion that the chances had been against me and that my friends were right after all. I was on a barren, rocky island, hardly a blade of grass to be seen, and no living thing except the sea birds which screamed over head. It was horrible, and I concluded that if the wind, which had now become quite strong, did not increase any more I would go out again. It was evident that the heavy waves at this place came through from the sea, this could be seen, because on the lee side of the island the water was smooth, and I knew that if I could cross the bay or fiord in front I could go on to my intended destination. At 5 P. M. I double reefed the sails, took off my coat and boots so as to swim if necessary, and shoved out into the cove ; the wind caught the sails, and the boat, like a race horse, started out into the waves.

It was grand and exciting, and to me awful. The waves which, from the shore, seemed but three feet high were nearer eight feet, the spray came over in showers, and it was evident that if the boat was not swamped at once she must soon fill with spray. I turned again, and fortunately got, a second time, into the cove. In a half hour more the sea was swept by a tempest. The wind went round to the north and blew up into the cove where my boat lay. There was plenty of ropes, and by means of the drag and various tackle I kept the boat off the rocks until midnight, when the rain came down in torrents.

I crept into the little cabin for shelter, and when the boat would strike would go out to haul in one or the other of the lines so as to keep her in the middle of the cove. The water raised two feet, and this alone saved my boat, as otherwise it would have been crushed on the rocks beneath. At 3 o'clock in the morning it was day, and the scene was not inviting. There had been a terrible storm, this was evident from the appearance of the sea. The lines holding the boat were worn almost in two where they rested in the chocks and on the gunwale, the boat was quite full of water, and it was cold and gloomy.

I sighed when the rashness of my adventure was thought of. Six hours later the sea had gone down some, and I decided to get out and run for Gothenburg. Fastening the various lines together to make up a warp tackle, I began warping the boat out against the wind. A long experience on the Ohio and Mississippi Rivers had taught me all kinds of expedients, except sailing, and after two hours hard labor and a tumble into the sea the boat was warped out to the mouth of the cove against the wind. Lying on the lee side against a bluff rock where the boat could not be stove by the waves, I took a loop hitch around a loose stone, so as to let go at pleasure and set the jib. No sooner was the sail up than its force dragged the stone. I sprang to the tiller and we shot out and around the point of rocks and made the lee side of the island. The mainsail was set, and in a short time I was flying before the wind at a rate which astonished me. In an hour I saw Elfs-borg Castle, and in less than two hours from starting was in Gothenburg, wet, frightened and hungry, but not defeated. The problem of Swedish sailing was yet to be mastered.

CRUISE NUMBER II.

The Göta-elf, or in English "Gotha River," is the largest one in Sweden, measured by the amount of water which flows through it, but in length it is a mere outlet to a lake system, the same as the Niagara is in this country. The river is scarcely 50 miles long, and has its source in Lake Wenner as Niagara has in Lake Erie, nor does the analogy stop here, for, like the Niagara, the Göta River tumbles over a cliff creating the Trollhätte Falls, which bear much the same relation to other waterfalls in Europe that Niagara does to other falls in America. They are the largest, and, as many claim, the most remarkable, but our business is not with Trollhätte now. The Göta, pronounced "yettah," after various somersaults at the falls, pursues its course in a measurably quiet way for about 30 miles, and then performs the freak of dividing into two parts of nearly the same size, each setting out on its own and a different course to the German Ocean. One branch goes to Gothenburg, or Göteborg, pronounced "Yetaborg"; the other, the north branch, called Northern River, runs at first to the north and then west to the ocean, the two mouths being twenty or more miles apart.

The island or peninsula between the rivers is called Bohusland, celebrated in song and story and the scene of many of those stirring adventures related in "Sturlesons's Sagas." Where the two branches of the river separate, on a high rock, surrounded by water, stands Bohus-slott, or castle, one of the most famed and romantic of the northern fortresses, and as a ruin, in some respects, the most remarkable. The inconceivable labor and money which it has cost would build houses for a Swedish province. Thousands of tons of immense stones have been dragged up this steep cliff, and battlements, towers, walls, dens, pools and so on constructed, which a hundred ages more will not destroy.

Not caring to again go outside with my boat until its management was better understood, I cruised about in the river and near to its mouth for a week or more, and then invited a party of friends to sail with me to Bohus ruin, or to "Kung-self," as the village is called which lies near the base of the hill on which the castle stands. Three ladies, an Englishman, and myself, with sundry hampers of eatables and drinkables, sailed from Gothenburg at 10 A. M., and in two hours had landed at Bohus castle, where the meal was dispatched in due time, and a most interesting visit paid to the old castle.

The wind, which had blown almost directly up the river, changed a little to east, and I questioned my ability to tack down for 10 to 15 miles in the narrow stream, and partly to a penchant for adventure, and partly from the difficulty named, it was proposed that the ladies return by the steamer, and that my English friend and I sail down the Nora-elf, come around the coast, and up to Gothenburg. It was a bold scheme. The Nora-elf is a rapid, dangerous stream, of which we knew only that it ran into the ocean; but, as said, the spirit of adventure was up, and away we went. The wind was, for the first ten miles, so that we could stand most of the time on one tack, the current was strong, the scenery fine, the day beautiful, and we enjoyed our trip; but when we approached the mouth and the river widened, we met swells which tossed the boat as though it would land it out among the reeds, with which the shores are lined.

It was the longest day of the year, and let me stop here to say that many readers will not know the full meaning of this phrase. The longest day in Sweden is nearly 21 hours from sun up to sun down. The sun skirts around the horizon instead of going overhead as in our country, and the nights during June are rarely so dark that one cannot see to read at midnight. We are, in fact, not more than 500 miles south of where one may see "the sun that never sets." Midsummer's day is a holiday in Sweden, an emphatic one. Without some qualification the term holiday has but little meaning here, they come along with surprising and, to a business person, with tiresome frequency, some times three in succession, and during "yule" time are so mixed up with business days that a practical American begins to think that affairs have ended altogether.

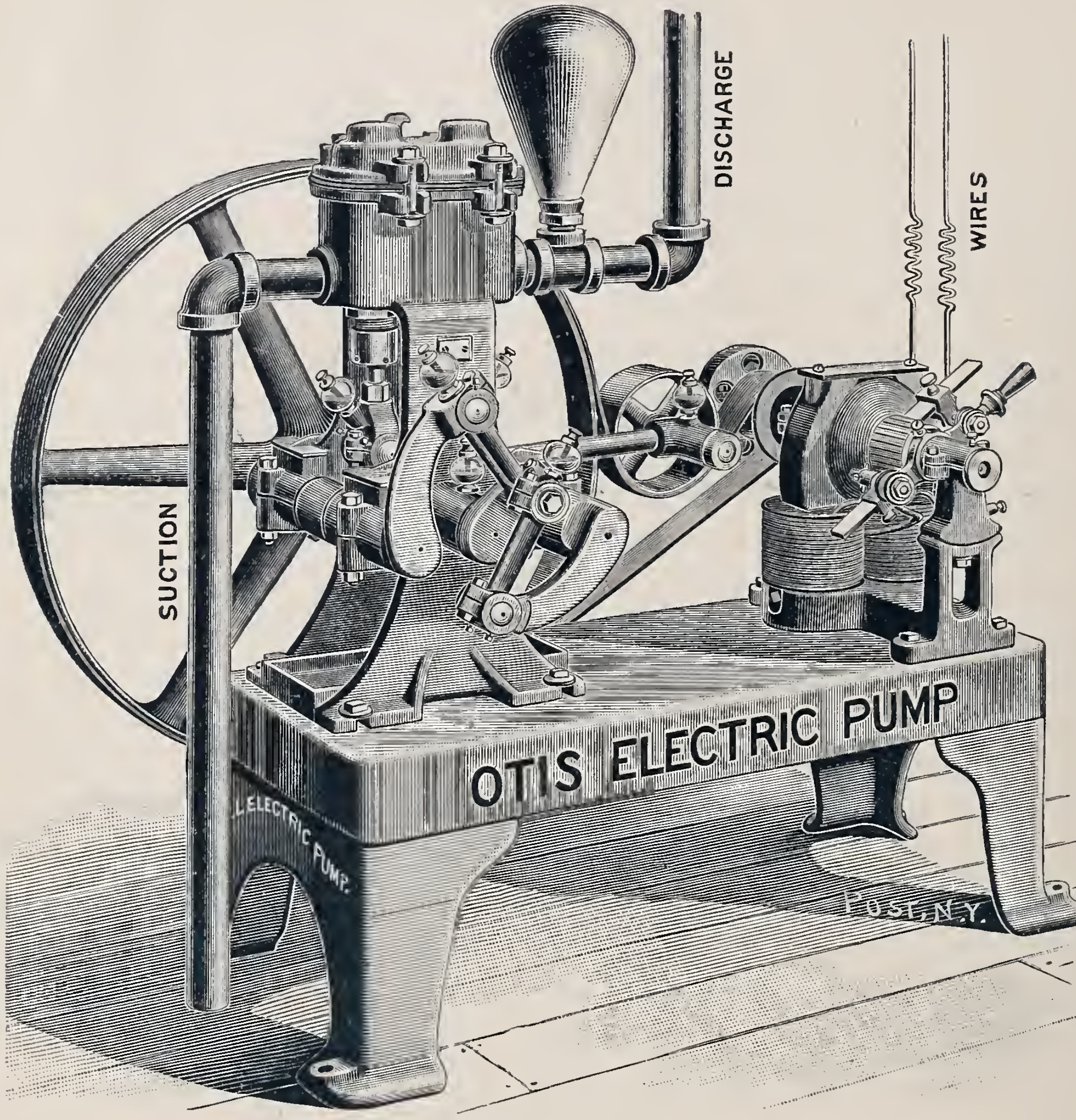
We got out to sea at last, or rather got out among the rocky islands on this coast, and became calmed. In these waters, during summer from 8 to 10 in the evening, there is usually a calm. The low angle of the sun's rays prevents the warming of the water, rocks and earth, as with us, and as soon as the influence of the sun's rays stop, I may say in a few minutes, a sensible change of temperature takes place, a chill comes on so suddenly as to suprise one, and this, of course, changes or reverses the air current so that wind from a new quarter may be expected. We were, by the river's current, drifting out very fast to sea through a wide gap before us; to anchor was out of the question in 30 to 40 fathoms. The boat was too heavy to row, and we waited anxiously for the wind which soon came, and we started for Göteborg. A little toy compass on my friend's watch guard kept the points in mind, and we sped along, in and out, around and between rocks, my friend standing on the bow, holding to the gib stay, watching for submerged rocks. The course was so tortuous that we could scarcely believe the minute compass. At 1 o'clock we entered a large bay, two to three miles wide, and when near the middle noticed that the sea had turned white, and to our surprise we found but 3½ feet of water. A level sheet of "white sand" was spread out on every side, and after cruising in several directions to hunt for deeper water we finally got hard aground, and laid down to rest for an hour.

These beds or plateaus of sand are a peculiar feature of the Scandinavian Coast. There is no tide, and, through some obscure law, these sand plains seem never to rise above the water and become covered earth. The sand is undoubtedly washings and wearings from the rocky coast, which are carried down into these coves or bays, the formation stopping when the depth of water is from 2 to 4 feet; at any rate there are thousands of acres of such shallow places. The exception is very deep water, that is, there will be either but a few feet or else many fathoms. When the light was stronger the mist cleared away, we got out of this singular bay, and after some hours of adventurous cruising sighted Elfs-borg Castle, and an hour later were at the dock in Gothenburg.

Many subsequent expeditions did not terminate so favorably. My little boat was more than once driven ashore, and more than one night I laid weatherbound behind rocks in the Skärgord; but one thing was demonstrated, that a rash American could, in an open boat, alone, and without knowing the coast, sail through the Swedish Skärgord, and even out to sea, and come back to write about it.

Every year many people, both strangers and natives, are drowned on the Swedish Coast and in the Swedish lakes by boats being capsized. Last summer, the editor of the *Aftonblatt* was drowned with his son by the capsizing and sinking of a boat on Lake Mälar, near Stockholm. The danger is, however, not great if proper precautions are taken, and if presence of mind is preserved when difficulties arise.

The first precaution, and one which would save people in most cases, is to have boats that will not sink. For every pound of ballast there should be carried air vessels or cork to counter-balance the ballast. The cork can be packed under seats and elsewhere, and the first experiment should be to scuttle a boat to see if it will sink. The next point is the sails. One person in sailing should never employ but two sails, and the sheets so held as to be instantly let go. With these precautions, a good ducking is about the only danger to be apprehended, and this need not happen if one is vigilant at all times.



DIFFERENTIALLY GEARED PUMP.

MESSRS. OTIS BROS. & CO., NEW YORK.

The pumping machine shown above, will furnish an interesting study for those interested in the geometry of link movements.

It is called an electric pump because especially adapted for driving by electric motors, in the manner shown in the drawing, the peculiarity being that the relative movement of the pump pistons is such that their aggregated displacement is the same for every part of the stroke, or, in other words, the flow in the suction and discharge pipes is regular and uniform. This causes a regular resistance to the driving power, which is a desirable or even indispensable feature in employing small electric motors for driving purposes.

The arrangement of the gearing will be made plain by the drawing. The pump pistons are driven by two bell cranks, and these bell cranks are both linked to a crank, as shown in front. The movement thus produced, the makers claim, leads to the results above described, a uniform flow and at an uniform resistance, which is the same thing in pumping.

This is the first attempt we have met with from the Eastern states of adapting double-reciprocating piston pumps to electric propulsion, and it seems a very complete one. Whether it is cheaper or better than the method employed here of three single-acting pumps combined, is a question, also another question whether any form of rotary pumps, such as have been tried, can be made to perform well and endure, in cases where electric motors are applied.

Messrs. Otis Bros. are makers of elevators, and the requirements of that business in the East, where power is extensively distributed by electric means, has, no doubt, led to the present very neat design.

THE GREAT SIBERIAN RAILWAY.

Among the wonderful railway undertakings of our time, the Russians have in hand the greatest, the trans-Siberian railway to connect the central Russian cities with Vladivostok, on the sea of Japan. The present inclement winter, and the famine in parts of the Empire have, in some measure, suspended operations on this wonderful line, but its completion is only a question of time.

The line will be, in all, about 5,000 miles long, and will, like our trans-continental ones, connect the Atlantic and Pacific Oceans, but over a wider continent, and in the face of physical impediments much greater than exist on this one.

The expansion of Vladivostok, and its conversion to a strong military and naval depot, is now the principal scare of the Russophobists in England, and the remedy or counter move talked of is an alliance with China, but this would be an ephemeral and inadequate means of opposing the Russian power at the "warm water," to which the great empire is sure to extend very soon.

It is useless to attempt to pen up a nation of nearly 100,000,000 people without access to the open seas of the world, and even the great power of Britain cannot do this much longer. Attempts to reach the Atlantic where open ports can be maintained have failed. Such a consummation is not possible without greatly disturbing the present map and political state of Europe. The Mediterranean is barred. The attempt through Finland to reach the spot where the

Gulf Stream impinges on the Norse coast and keeps open water was a failure, and now the Russians have started the other way, toward the Northern Pacific, keeping within their own dominions, and as far away from British interests as is in the nature of things possible.

Our own opinion is, and it is based on a considerable discussion of the matter in England, that the danger to the British Indian possessions have been greatly exaggerated, and the main dread of Russia has not been of conquest, but of trade and a rivalry of power on the seas, which may follow if Russia reaches open water on either ocean. Britain and Russia are the great powers of Europe. Others sink into insignificance in comparison. Great Britain rules over 300,000,000 people, but they are scattered around the globe. Russia has only a third of this number, but they are concentrated in one state, bound mainly by one faith, and loyal to a government that has absolute control. Napolean saw the future of the Muscovite in his celebrated prediction that "Europe would be either Republican or Cossack in a hundred years."

The great railway is only one link in the great drama that is preparing, and which, before consummation, means a loss of human life and wealth which is appalling to consider, but, at the same time, unnecessary if national selfishness and the "jingo" spirit were eradicated.

That the commercial power of the Muscovite Empire could, within any reasonable period, cope with that of Great Britain and the southern nations is something no one believes, but the plans of the great powers extend much farther than we are accustomed to look, and reaches far into the future.

It was shown in this Journal, some time ago, how, in the commercial polity of England, schemes extended over a century. In the case of the Hudson Bay Company, and in this matter of Russian development, it is not the present that concerns Europe, it is the future, the remote future, with which our generation has no direct personal concern.

The great railway will cost at least $200,000,000. Its revenues are set down at $16,000,000 annually, and its maintenance at $2,000,000 more, but as a strategic line the loss would not be considered. It is believed, however, that, in a few years, the revenues would so increase as to afford a clear profit, and this is likely.

PROFESSOR THURSTON ON THE TARIFF.

Prof. R. H. Thurston, of Sibley College, Cornell University, has found time among his technical pursuits, to study the philosophy of Henry C. Carey, and has contributed to *Cassier's Magazine* an article on "The Tariff and the Constructive Arts."

The writings of Henry C. Carey, to those who personally knew him, require no explanation. To others it will be enough to say that their burthen was the exhaustion of other countries by Great Britain, to her own aggrandizement, by means of laws just such as Carey continually recommended for this country; when, as a matter of fact, there was no England, such as now exists, until after her repeal of the navigation and impost laws between 1840 and 1850. Her colonial policy, and its results all over the world, are just the reverse of what Carey claimed would take place. He was accustomed to assert that it would be a blessing if the Atlantic Ocean was a burning cauldron of fire to prevent communication with Europe.

We have neither inclination nor space to review Prof. Thurston's remarkable essay, or to discuss the ethical platitudes thus refurbished after the world has not only quietly laid them to rest, but forgotten them ; but will suggest that if economic science is a part of the curriculum at Sibley College, and is taught on the lines here indicated, it is quite time that Professor Thurston applied to this branch the methods he employs in physical science. The following quotation from the article will show what we mean :

"Every educated man leaves college a 'free trader'; every man entering into business life as a member of the producing or of the commercial classes—those above excepted being here excepted also—at once sees that somehow, his theories and deductions from economical 'axioms' fail of application in practice; and while admitting often the 'theoretical' correctness of the principles which have been instilled by his professors, nevertheless asserts that 'practically' the opposite course is right. All protectionists are business men; substantially all antiprotectionists are theorists or of the salaried classes. In this country the two sides are engaging as counsel the professors and college men and the importers and their interested friends as advocates of 'free trade' and the manufacturers and dealers and educated wage-workers as advocates of protection to home industries. But why this apparent discrepancy between pure and applied political science?"

The above, if it require comment, is to admit that so long as students and others consider common instead of personal interests, they are opposed to protection, but as soon as they are business men and their private interests are brought into play, they take an opposite view of what is called protection. This forms a dubious argument for a tariff, certainly; is, indeed, admitting fully the principal objection urged against one, in so far as equity, that is, that the impost duties act in the interest of what the Professor calls "business" people.

This, and some other articles in the same number, the third one of the magazine, are suggestive, and bring to mind Assistant Postmaster-General Clarkson's speech at the Quay banquet in Pittsburgh last summer, when he deplored the fact that the literature of the country was against his party.

PUBLIC WATER-WAYS.

The late conventions at Detroit and in Kansas City, to deliberate over "Water-Ways," could well be supplemented by a National one and a permanent organization that would exercise control over Legislation to some extent as the railway interests have done. There is no doubt whatever that in the craze over railway communication, the enormous and in many cases unjust concessions that have been given not only in money and land but also in an immunity from various inquisitive and exacting laws, such as are applied to water craft. The people of this country have become blinded to the advantages and importance of their free water-ways.

We say free water-ways in a restricted sense, because in some cases, as in the Ohio and Mississippi rivers, the traffic has to some extent been controlled by combinations of private companies, but this is of no importance compared to the various obstructive and annoying regulations that have emanated from a congress of railway men. On the score of licenses, inspection, taxes of one kind or another, and a complicated system of clearances, declarations, enrollments, and what not, our water craft are bedeviled from the time a keel is laid until the bones of a vessel are bleaching on the shore.

Why are the qualifications of masters, mates, engineers, and pilots, so carefully looked into, when railway train officers receive no attention at all? Both carry passengers and both have perils of a common kind, or resulting from a common cause, the want of qualification in the men in charge. The fact is that for thirty years past every invidious act that could be forced through Congress to cripple water carriage has passed under the guise of "protecting the public."

In the Detroit convention there were passed some resolutions that contain a good deal of irony, as follows:

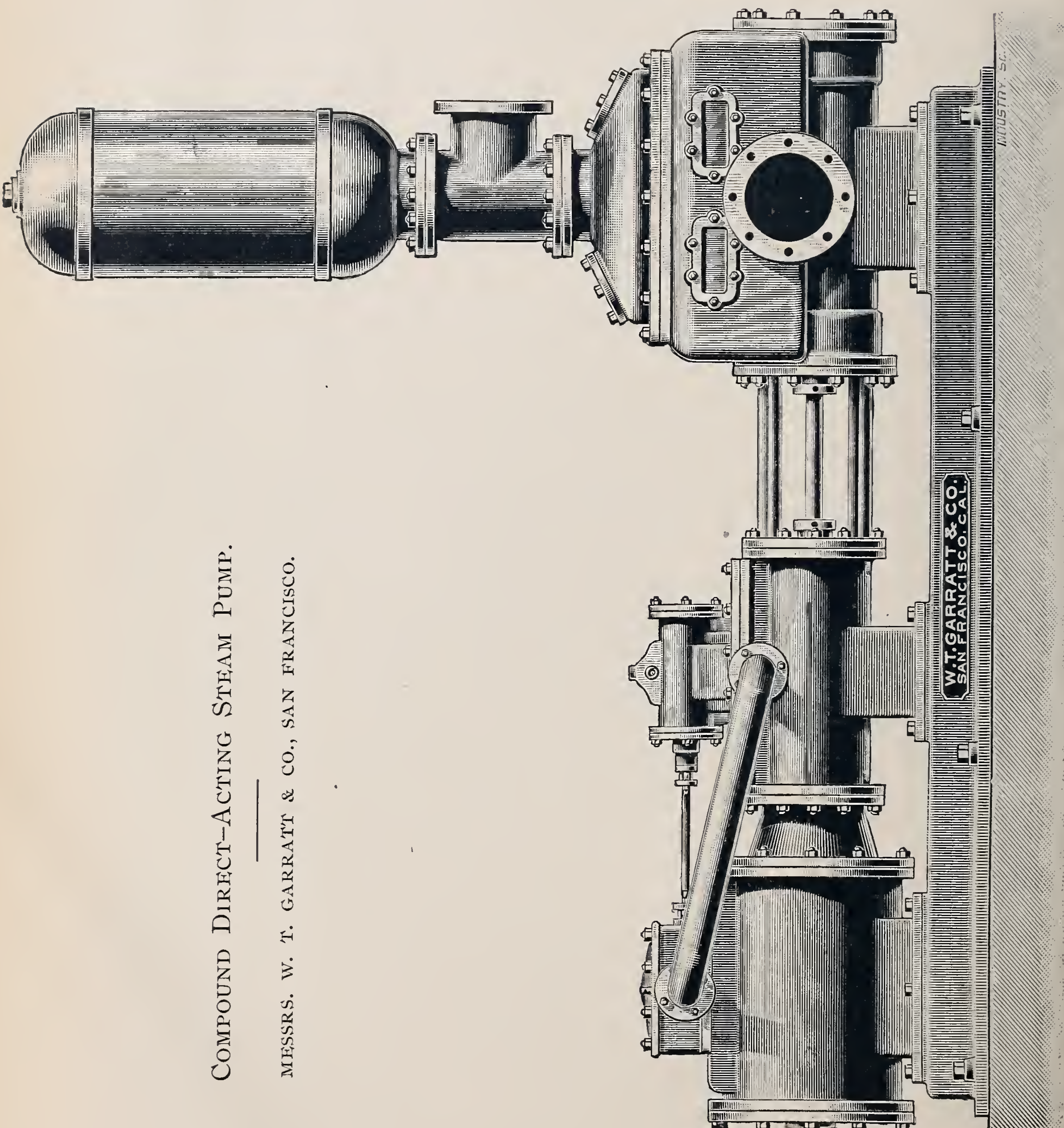
Resolved—That this convention most heartily approves the action of our government in aiding by loans of its credit the Pacific railways, at the period of the commencement of the work, when there was an apparent great necessity for that aid. And be it further

Resolved—That the time has now arrived when the sums of money so loaned, and interest, amounting to $112,000,000, should be collected as soon as possible and devoted by the government to the great water-ways of the country.

It is to be hoped that the "water-ways" will not have to wait for this money, which is yet a long way from the National treasury, let alone its reappropriation in the interest of water carriage.

Four hundred miles of the great valley here in California right and left from San Francisco, has water-ways that are, or could be made available if the spirit were in that direction, but the difficulty is that such water-ways would be open to the use of the public and the detested private carrier, and totally unlike a railway that can be used only by its owners. Free water-ways would be a relapse to that old system which recognized an equality of rights and privileges in all that concerned public use and public service.

The Traffic Association has enough urgent work laid out for some time to come; lighter work than the conservation and improvement of California's water-ways, but they will in due time arrive at that, if the organization is born of, and conducted in the interest of the public welfare.



COMPOUND DIRECT-ACTING STEAM PUMP.

MESSRS. W. T. GARRATT & CO., SAN FRANCISCO.

COMPOUND DIRECT-ACTING STEAM PUMP.

MESSRS. W. T. GARRATT & CO., SAN FRANCISCO.

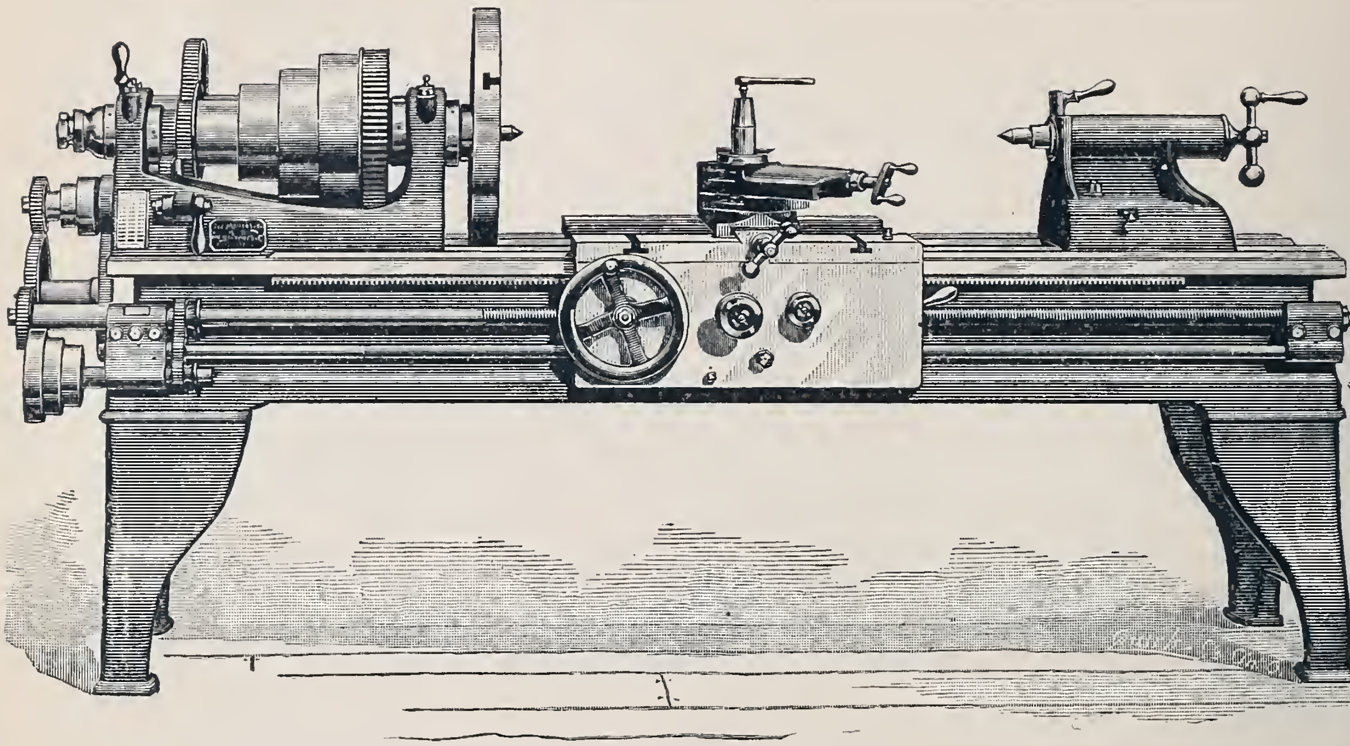
The engraving opposite, sent by Messrs. Garratt & Co., is a true side elevation of one of their latest designs for compound steam pumps, and the drawing is a good example of what can be done by a skillful engraver with a flat elevation, or one in true projection.

Of the engines and pump but little description is required. The valves on both steam cylinders are moved by a steam piston, placed over and connected with the slide valve of the initial engine, and by a piston rod with the slide valve of the low pressure or second cylinder. The steam distribution to the valve gearing is by the Hooker system, operated by tappets in the initial cylinder.

There is, or has been, a good deal of objection to engravings made in flat elevation because of the want of shades and tints, but the one shown proves that fine pictures can be made from geometrical drawings, or from blue prints of "shop drawings," as was done in the present case.

One of the first engravings in true projection that has come to notice, was of a steam traveling crane, engraved by Messrs. Dalzell and Markley, of Philadelphia, for the Dickson Manufacturing Company, of Scranton, Pa., about twelve years ago. Messrs. Hare & Co., celebrated machine engravers of London, began making such engravings from shop drawings about twenty years ago, and some progress was made in Philadelphia later on, in imitation of Hare & Co., but, as before remarked, Dalzell and Markley were among the first who succeeded in making good pictures of the kind.

The present engraving was made by A. H. Markley, of Philadelphia, successor to the firm named, and, as will be seen, it has the same effect in tints and shades as a drawing in perspective. The system is one of great convenience in many cases where photographs or perspective drawings are not available, or are too expensive. All that is required are working drawings in two views, so the artist can ascertain the position of the parts in two planes.



IMPROVED ENGINE LATHES.

We examined, recently, at the warerooms of Messrs. Rix & Birrell, of this City, some engine lathes that show a considerable advance on common practice.

The spindles were about double the size and strength common some years ago, and were made hollow, as all lathe spindles should be. They were made of forged steel, hardened and ground true, a thing that a short time ago was thought to be a needless refinement, but now acknowledged here as it has long been in England, a necessary provision for high-class lathes of small size.

The lathes in question are shown in the engraving above, which is very near a true elevation, indicating the proportions of various parts, and having in front, the geared connection between the screw and feed rod, by means of which the slide rest can be traversed either by the rack, or the screw, at pleasure. The work seems to be well fitted, the material good, and the whole, as before said, indicating an advance in practice.

Lathe makers, of all others, are the slowest to improve their machines. The projection of the sleeve of the sliding head inward over the slide rest, so the tools can be run back "past" the end of a piece in the lathe, is an obvious advantage, but that adds the same length to the main frame, to turn a given length, so no one does it. The cones, as well as the main spindle, should be geared to the screw, so screws of coarse pitch can be cut without overstraining the change wheels, and the back gearing should have three instead of two pairs of wheels so as to avoid running the cones at a destructive speed when turning small work with the lathe back-geared. These things have all been tried and proved for years, and are, we believe, not patented, still have not come into use, but it is a comfort, however, as in the present case, to see some real advance in proportions, fitting and adjustments.

A COAL MEASURE FOR STEAMERS.

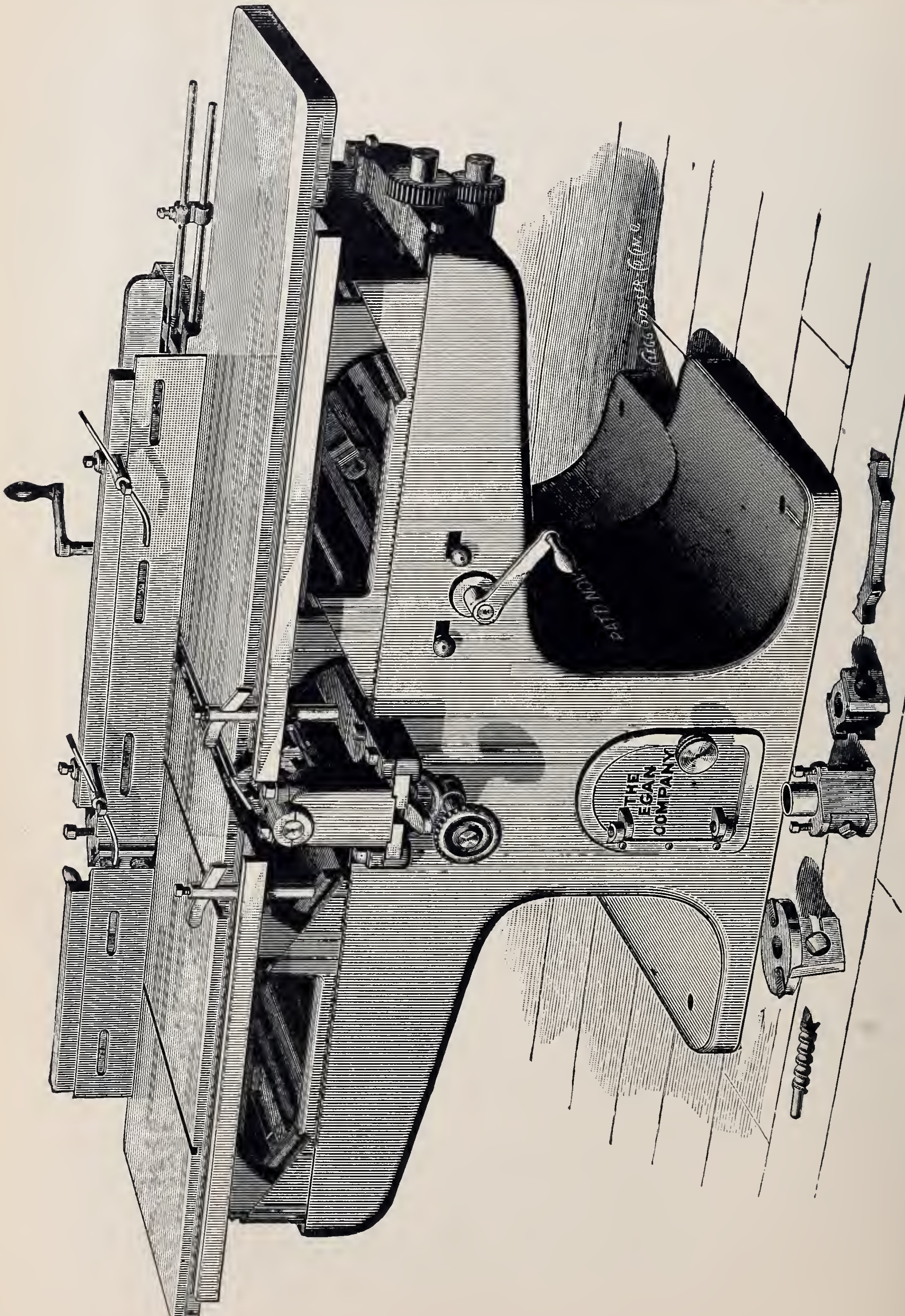
The marvelous perfection of modern marine engines has been exemplified by a run recently made by the steamer *Tekoa*, belonging to the New Zealand shipping company in England, the vessel was built at West Hartlepool, England; is of 4,050 tons gross measurement and carries 6,250 tons, her engines are of the triple type, 27, 43 and 72 inches diameter, and stroke of 45 inches. In a recent run from Teneriffe to Auckland she steamed 12,059 miles at full speed without missing a single revolution or stopping the engines. From London to Auckland is 13,772 miles, and this distance was run at the rate of 10 knots an hour, the consumption of coal "for all purposes" being only 21¼ tons a day.

A set of new engines in this case made "sixteen millions of revolutions" without a "pull up," and without adjustment of any kind not made while the engines were in motion, but aside from this is the cheapness of carrying, a feature that is just now receiving more attention than ever before.

The *Tekoa* carried a ton of freight, 2,240 pounds, 13,772 miles with less than 448 pounds of coal, or in other words, will convey freight 68,860 miles with its weight in coal.

It would be a very good way to rate steamers by the distance they will carry freight with an equal weight of coal. It would be a method of measurement that will take in all the factors except time, and this could be assumed as constant at 10 knots an hour for freight vessels, with increment of speed for increment of coal, in some established proportion.

At the present time it will be approximately correct to say that a steamer should carry cargo 50,000 miles with an equivalent weight of coal at a speed of ten knots an hour. One thing is sure, the cost of water carriage from this time forward is going to be looked into more than in the past, and correspondingly cheapened.


THE EGAN COMPANY

UNIVERSAL WOOD-WORKING MACHINE.

THE EGAN COMPANY, CINCINNATI, OHIO.

The machine, shown on the page opposite, belongs to a comparatively new class, but very well known in this country. It is of the combination kind, capable of performing a variety of different operations, and corresponds to what is called in the Old World a "general joiner," but is directed to certain job work instead of general purposes, as will be explained presently.

Combination machines, in all of the processes of "regular" manufacture are of no use whatever, but as supplementary machines are indispensable in attaining system in a shop. A set of standard machines in a common factory without a combination "relay," is the next worst thing to an equipment of combination machines, without the standard or single function ones. Both are necessary at this day in all cases where jobbing or special work has to be done, as well as regular manufacture, and that means in nearly all cases, because there is no shop, no matter what its purpose, that does not have special work to do ; their own work if no other.

It is not only a problem of machine adaptation, but also of the division of labor. A universal machine, like the one shown, will, in any large shop, furnish work for a man who understands all the various changes of the machine, knows where all the cutters, saws and fixtures are that belong to it, and how to apply them. His business will become the performance of jobs that would otherwise disturb the regular machines and the men who attend them. The necessity for these universal machines came in with the large organized shops, and they did not appear until long after they were needed, because of a justified prejudice against combination machines to save the price of divided ones ; also because such machines were known only in connection with small shops, where they supplemented hand work and the amount of business was such that the sawing, planing, moulding, rebating, grooving, and so on, could be done, one at a time, on the same machine.

This was the "general joiner" idea in Europe, and is now, to a great extent. Builders there commonly do their own machine work in preparing material, and a general joiner, or combination machine, answers very well in such cases. It is commonly taken on the ground where a building is to be erected, and the material prepared as used, or the builder has a small shop where only his own work is prepared. Such machines are commonly arranged to make mortises with routing tools and tenons with saws, but this is carrying the matter beyond American endurance.

The capacity or range of work that can be done on a machine like the one illustrated is wonderful. The front, in the picture, is only a hand-planing machine, but the spindle is arranged to receive cutters of all kinds, saws, or other tools, and the fence or gauge to produce bevels of all angles. The rear end of the spindle is mainly for "end tools," such as are employed for boring, routing, recessing, and so on.

We will not trouble our readers with the dimensions of parts and qualities of the machine shown. The name of the firm who make the machine should be a guarantee of these things. The object is to point out that a combined machine out of place is a mistake and useless, and one in place is indispensable to the proper conduct of a wood-working establishment.

Combination wood-working, or universal wood-working machines were, in this country, first invented and used in Ohio, near where the above one is made. They came in with what may be called a *rennaisance* of wood-working implements from 1865 to 1875, and if there has been one put in use that failed to give satisfaction, in so far as its objects, we have not heard of it, up to this time. Messrs. Egan & Co. make several sizes of these machines, also modify them to suit particular kinds of work.

BAND SAWS.

The *Wood-Worker*, an authority no one will question, in speaking recently of band sawing, says: "This last victory makes the band saw almost complete master of the situation in the United States." Every one has some pleasure in deferred consummation of their prophecies. The writer, in 1872, went to France to procure band saws and to see what M. Perin had accomplished in band sawing. On his return there was constructed by his firm in Philadelphia, a large band saw mill for George Law, of New York, the engineer who built the Panama railway and the Harlem high bridge. This mill was erected at the foot of Tenth street, on East River, New York, very near to two French band-saw mills of much smaller size, then running on large poplar and walnut timber.

The Law mill had saws 50 feet long, 6 inches wide, and was employed mainly for cutting out deck plank "with the grain" up to 90 feet long. When this machine was made there was, so far as known, only one man in New York who thought it would succeed. That was Mr. Van Pelt, George Law's manager. He made the machinery succeed, but it is many years, more than twenty, that have been required to evolve this apparently simple art of band sawing in this country. A little later, about 1874, two machines for saws 48 feet long were made to the order of the Central Pacific Railway, of California, and sent out one to Sacramento where it is yet in use, and the other to some point not now remembered. The making of such machines has been continued down to the present time by the firm, now the Berry and Orton Co. of Philadelphia, but with such changes and improvements that few if any of the old features remain.

COMMERCE DESTROYING.

New schemes for destroying people and property are commonly over-estimated, and this is, no doubt, the case in respect to "commerce destroying," set up in the late report of the Secretary of the United States Navy. For about a hundred years past piracy has been considered a capital crime, and we think that to propose commerce destroying at this day is not a very creditable suggestion. Practically, there could not be much in the scheme. What could a cruiser do with a first-class modern steamer that has commonly from 500 to 1,000 people on board? To take the people off on a war steamer would not do, and a prize crew would be equally out of the question. Some years ago there was an international convention to consider the expediency of a mutual agreement that commercial vessels should not be attacked or molested in time of war, and this was much nearer in the line of humanity that our age boasts of. The Secretary of the Navy should have omitted this commerce destroying matter. The best thing in war is that which tends to end it, and commerce destroying has not proved one of that kind.

MINING NOTES.

The Harney Peak Consolidated Tin Company have, it is said, given a mortgage of $5,000,000 on the Black Hills mines, and will thus secure the capital required to erect reduction and other works. It seems impossible, in the conflicting accounts one reads of the Black Hills mines, to form any exact idea of what really exists in the way of tin, but to borrow this amount of money there must certainly be value of some kind in the property of the company.

There is a good deal that indicates great activity of the gold and silver mining industry for the coming year. Some satisfactory method of resuming hydraulic washing is probable, and as soon as Congress stops tinkering at the silver problem its value will, no doubt, advance. It is the opinion of a good many, and it happens to be people most likely to know, that a free coinage act would still further depress the price of silver, and, if so, it would not be the first time that legal meddling with values has produced an effect just the opposite of what was intended.

Mr. C. G. Yale, the editor of the *Mining Press*, in this City, who is a member of the executive committee of the Placer County Mining Association, has attacked, in a vigorous manner, some rulings of Assistant-Secretary Chandler, of the Department of the Interior, on the evidences of "mineral lands," and with good reason. The Secretary thinks proofs of the existence of minerals should be furnished before lands are declared "mineral," and has, to use a common expression, "got his foot into it." Mr. Yale does not need assistance, and notice of the matter here is to remark that the subordinate administration of government bureaus is often of the "Tite Barnacle" kind. How can we, under a system of continuous office rotation, command skill in such administration? The chances are, as Mr. Yale claims, that the assistant secretary knows nothing of mining, and it is scarcely to be expected that he should. To produce evidence of minerals under a lava cap hundreds of feet in thickness, or in the center of a mountain, would be a profitable business out here, and if Mr. Chandler knows of any means to that end he had better resign and come out to this Coast as soon as possible.

The total gold yield in Alaska for 1891, is set down by a correspondent of the *Engineering and Mining Journal* at $1,250,000, which, to most people, will seem discouraging, especially as the great Treadwell mills, on Douglas Island, contributed about three-fourths of the whole. Outside of this mine the industry is widely distributed, the Silver Bow Basin Co., having taken out $60,000, where any return whatever was problematical. Taking the whole of the news of last year respecting Alaska, or, indeed, any other mining section where mining property is being bought and sold, there is an enormous amount of untruth to sift from, and much caution is required in dealing with such news. It is not particular facts as given, so much as general inferences that must be guarded against. The present year will determine pretty well what the future prospects are of Alaska mining.

The report of Majors Benyuard, Heuer and Hanbury, of the United States Engineer Corps, on the debris problem reverted to in our last issue, contains the following estimates:

"The commissioners computed the amount of land along these streams ruined by hydraulic debris as follows: Along the Feather River, 17,628 acres, valued at $1,097,038; along the Yuba River, 11,845 acres, valued at $1,097,577, and along the Bear River, 9,741 acres, valued at $694,970. In addition, lands adjacent to these rivers had been injured, though not destroyed, to the following extent: Along the Feather, 6,940 acres, damage, $195,750; along the Yuba, 3,500 acres, damage, $144,500; along the Bear, 3,515 acres, damage, $82,200; making a total of 39,214 acres lost, valued at $2,871,585; and of land more or less injured, a total of 13,955 acres, damage, $422,450. These figures also cover the damage caused by the flood of 1890, which amounted to a very considerable sum. On the other hand, $10,000,000 is being lost annually to the State, and the foothill counties have lost more than 50,000 in population by the judicial decisions prohibiting the working of the auriferous gravel beds of the State. The commissioners in their report expressed the opinion that in many instances the conditions are such that the mining debris could be so impounded that no interest, property or pursuit would suffer. The cost of the several works recommended by them was estimated as follows: Feather River wing dams, $300,000; Sacramento wing dams, $300,000; dam on the Yuba River at the Guerre Point, from $300,000 to $640,000, according to the height; dam on the Bear River, $150,000; restriction works on the Yuba River below the foothills, $300,000; and $20,000 annually for maintaining navigation on the Feather River.

Eissler gives the following particulars :—A gold mill requires 130 pounds of quicksilver per stamp, the monthly loss of which is about 1 pound for every 30 tons of rock crushed. The wear of the blankets is over a yard a month. A 5-stamp battery requires on an average 13 sets or screens a year. A set consists of 5 sheets of from 1 to 1¼ square foot. A good shoe lasts from 21 to 43 days (on an average 33 days), and crushes 79 tons of rock ; rhe wear is 1⅛ pounds of iron per ton of rock. The die lasts on an average 7 weeks, crushing 100 tons ; the wear is $\frac{6}{10}$ of a pound of iron per ton of rock.

The proposition of Congressman Camminetti, of this State, to found a department of mines in this country, deserves promotion. That the Department of the Interior cannot deal with this industry as its nature demands, has been shown in various ways last year, and even the compilation of statistics has been left to private enterprise in so far as any useful form of them. Anyone who will look into a report of the inspector of mines, in Victoria, Australia, will see what is required in this country. We might not be able to attain the elaboration of one of these reports at once, but it is a poor reflection on our system of statistics, very complete in other things, that we have none of mining that can in any way compare with other countries, even small countries. The Department of Agriculture has been a success. One of manufactures, and one of mining, should have equal success.

The Fort Scott Foundry and Machine Works, Fort Scott, Kansas, have been succeeded by the Walburn-Swenson Manufacturing Company, who have decided to at once construct what should long ago have been among the enterprises of this City ; an ore testing and concentrating works, with a metallurgical and assay laboratory. It will be hard to point out in this country, even in dense manufacturing centers, an engineering works that has made more rapid strides than the one named above, and no little of their success has been in the engravings, circulars, and the manner of illustrating their work. Their sugar machinery catalogue is a masterpiece of good taste and lucid explanation. Of late years they have given a great deal of attention to mining machinery, especially for smelting and concentrating works, of which the company have constructed a large number in various parts of the country.

That there are profits in the mining industry will be proved by the following list of dividends for twenty of the leading silver and gold mines in 1891:

Granite Mountain, Montana	$1,400,000
Bimetallic, "	840,000
Elk Horn, "	375,000
Mollie Gibson, Colorado	1,000,000
Aspen Mining and Smelting Co., Colorado	100,000
Best Friend "	70,000
Little Rule "	120,000
New Guston "	440,000
Enterprise Group (first quarter) "	250,000
Centennial Eureka, Utah	330,000
Mammoth, "	320,000
Horn Silver, "	200,000
Daly, "	450,000
Ontario, "	900,000
Con. Cal. & Virginia, Nevada	216,000
Cortez "	250,000
De Lamar, Idaho	150,000
Lake Valley, New Mexico	80,000
Alaska-Treadwell G. M. Co., Alaska	450,000
Homestake, Dakota	150,000
Total	$8,091,000

The condition of the quartz mining industry in California in 1891 has been fairly prosperous, and nearly all of the old mines along the Mother Lode that were worked in 1890 have been worked during the year just closed with equally good results. Some of them have done decidely better, the Kennedy, at Jackson, especially, it having paid $360,000 in dividends during the year, which is as much as the company paid in previous years put together. The famous old Idaho mine, at Grass Valley, has also done well. It is impossible to say, at the present time, what the amount of California's yield of gold in 1891 is, but even if it proves to be no greater than that of 1890 it is quite certain that the profit has been greater. Every year sees the introduction of improved methods of mining and milling, and quartz which could not be handled ten years ago is now worked at a profit. Indeed, the year just passed has been quite notable for the number of old, abandoned mines that have been reopened. Nevada and Amador Counties have continued to be the center of the quartz mining industry of the State, but the upper or northern portion has been attracting considerable attention. In Siskiyou and Trinity Counties blue gravel in large quantities has been found, and great hopes are entertained that the deposits are of as good grade and as rich as the deposits in the central counties.—*Eng. and Mining Journal.*

LITERATURE.

Report of Agricultural Stations.

UNIVERSITY OF CALIFORNIA.

This Report, by Prof. E. W. Hilgard, Director of Experiment Stations; printed at the State Office, Sacramento, contains 330 pages of matter, and looking over its contents the first thought is: What a mass of useful work to be wasted on the few who will profit by it! As a rule, agricultural pursuits gain less by recorded experience, that is, by printed literature, than any other great industry, and one of the reasons for this is the diversity of circumstances and conditions that attend on agriculture.

This diversity is forcibly illustrated by a remark of Prof. Hilgard in his "letter of transmittal," in which he says:

"The unfamiliar practice of South Spain, Egypt, North Africa, Asia Minor, and the northwest provinces of India, rather than that of the eastern United States, forms the basis upon which the greater part of California must build its own, profoundly modifying many of the current practices of the older states. The incredulity with which so many of the most familiar and daily occurring phenomena of Californian agriculture meet at the East (not uncommonly to the extent of being characterized as "another California yarn"), admonish us that our line of investigation is necessarily laid in different and new directions; and that while we should sedulously avail ourselves of every possible source of information afforded by Old World and Eastern practice, yet to follow such precedents blindly and without careful consideration of the characteristic differences induced by climatic influences, would be to court failure in the majority of cases."

This is a remarkable statement, yet true in every sense, and is a strong argument in favor of the establishment and maintainance of experiment stations such as the University has founded at Berkeley, Alameda County; Jackson, Amador County; Paso de Robles, San Luis Obispo County; Tulare City, Tulare County, and Pomona, Los Angeles County, also their viticultural stations in the vine districts.

The work is divided into three sections; the first, devoted to laboratory work, which, in technical parlance, we would call "the nature and properties of materials," dealing with soils, waters, marls, etc.; also the chemical actions and reactions involved in growth; second, an account of culture work done at the several stations; and, third, on entomology and insecticides.

What the arrangement may be for the distribution of this report we are not aware, but will suggest that its wide dissemination would add some millions to the industrial product of the State. It is true, as before remarked, that farmers do not profit as they might from information presented in this form, but it is equally true that in future agriculture will more and more become a science with a field so wide as to become bewildering when we consider it, and it is also evident that it will on this Coast call for distinct and different study from any and all other parts of the country.

Prof. Hilgard must be complemented on the comprehensive and scholarly report that has been presented this year, and the apparently successful operation of the department over which he presides.

The Locomotive Engineer.

The extension, it may be called, of this journal, and its ownership and editing passing into the hands of Mr. Augus Sinclair and John A. Hill, its former editor, is a considerable fact in our technical journalism. The former conduct of the *Locomotive Engineer* was fearless, and successful for that very reason. We mean it was not afraid of the truth, and dealt in that commodity as far as it could be determined. Both of the editors are practical railway engineers, in both the narrow and wide meaning of that term, and there is no reason why its circulation should not become as extensive as the interest it represents. Mr. Hill was, last summer, a visitor here on this Coast, quietly observing what we are doing, and the manner of it. His comments, when asked for, were of a kind so candid as to be startling sometimes. The influence of the journal, technical and ethical, will be a considerable fact in railway economy of this country.

The Engineering Magazine.

FEBRUARY, 1892.

The above issue contains the usual amount of original matter. One article on the decline in railway building in this country, by Mr. Thomas L. Green, contains a large amount of suggestion for those engaged in promoting such works, and lays stress upon the fluctuating nature of railway earnings under fluctuating business. The last paragraph is as follows:

"Such a period of distrust we are now passing through. American railroad securities and Argentine cedulas are in Europe alike under suspicion, but there is no connection between the two. It is proper to take the opportunity during the pause to say that railroad extensions, when warranted commercially, are worthy of approval and worthy also of financial support, though the argument for them should be sustained conservatively and through the application of good business principles."

An article on the gold fields of South Africa, will be a matter of some surprise to most people who have come to think that the only mining in that country is at Kimberley, and the only product diamonds. Of these, Mr. Hallé, the writer, says: $20,000,000 in value have been taken from some of the pits, and it is no wonder that other mining interests are overshadowed. In speaking of the district of Witwatersrand, it is claimed it has produced a larger amount of gold for a given area, and in a given time, than any other place in the world. A strip thirty miles long and a half a mile wide produced in October, 1891, 72,793 ounces, or about one and a half million of dollars worth.

Of American mining in 1891, Mr. Albert Williams says in an article contributed:

"1891 has been a great year in American gold and silver mining, on the whole more satisfactory than any previous one; not a period of excitement, of startling discoveries, of wild rushes and booms, but of tranquil prosperity. It has been characterized by a considerable extension of the known mineral areas, better distribution of profits, and a heavier production than ever before. This too, in the face of a depression in some other branches of industry, and with lower prices for some of the more important products, showing that precious-metal mining stands almost alone in being independent of the general course of 'the times' in commerce, manufacturing and the other productive occupations. Without the evidence of trustworthy statistics, such a state of things would hardly be expected to exist."

Lieut.-Colonel King, of the United States Engineer Corps, undertakes to defend the government engineers from the attack of Mr. Wisner in the January number of the Magazine, and has not succeeded nearly so well as could have been desired. That much failure as well as much success must be charged up to the corps is undeniable. Of the work done in the Upper Mississippi, for example, and wing dam building generally.

Captain Bell, of St. Paul, Minn., says wing dams alone "are of no use," and we believe him. Colonel King's recollection and statement of the Corps' opposition to Captain Eads, is by no means what a good many other people will recollect of this matter.

The machine shop notes in the present issue are of much practical value, and are evidently written by some one not of the *New York Times* staff. Considering the range of subjects these notes are spread over, and their nature in each case, they are remarkable. We will quote two of them chosen at random:

"You want to get screws with a metric pitch, for that Persian job, and don't know just how to make your lathe walk Spanish? Few things easier. Make a translating gear having on one stud two wheels, one with 50 teeth and the other with 157. Their ratio is 1 to 0.3937, and that is about as close as you will be liable to get anything; for the lathes that work to fine decimal points are few, and the men who will do it on them just as few.

About the best way to get a working drawing of a complicated piece, where the outline is very complicated, or the exact shape of the curve is an important factor, is to make a blue print from the original sample itself. The watch makers and makers of watch-making machinery do this with great success and satisfaction."

Machinery Pattern Making.

BY P. S. DINGEY.

It is a little strange that pattern making, or model making, which is a better term, should have so little in the way of treatises and writings. It is, unquestionably, one of the most intellectual among mechanical trades, involving as it does, not only the constructive part of how to make patterns or models, but also how they are to be used, and, to a great extent, the art of moulding.

Perhaps this paucity of writings is due to the fact that the construction and scheme of machine patterns does not admit of fixed rules. There are not only several ways of making almost any pattern, but there are several grades of quality, ranging from a rough "strike," or edge board, to the finely varnished model with box fillets of hard wood, and corners of brass. We have seen wooden patterns from which three hundred castings have been made—a main frame for a band-sawing machine, and also have seen the same casting produced in England from a "knocked up" form that cost one tenth as much as the American pattern.

In such an art as this one need not wonder much that writers do not care to venture upon the subject, and how difficult it would be to frame rules or instructions to in any measure compass the whole. This, Mr. Dingey has understood, and has confined his work to those things which admit, in some measure, of rule, but an important part, and as it happens, to things least understood. In his remarks on machinery he recommends transverse or Daniel's planing machines, and says this machine "is one that no pattern shop should be without." This we endorse in every way, and have always so contended against common opinion and practice on this Coast.

The book contains 376 engravings, and it will be a dull pattern maker who fails to learn two dollars' worth from a copy.

It is sent by Messrs. Osborn & Alexander, of this City, for notice.

Steam.

This book is sent by Messrs. Osborn & Alexander, of this City, and is one of the kind that relieves the tedium of review writing. There is nothing to do but to recommend it, and in this case without reserve. There is no book of a technical kind more often asked for than an elementary one on steam and the steam engine, as the art and practice of today stands.

The common answer is that none exists. Eminent steam engineers do not write elementary books, that is, they do not want to do so, and it is not to be wondered at. We are all, more or less, given to pedantry, if that be not too harsh a name. We want to show our "best goods," and appeal to the highest class of clients, and in this way the student and apprentice are ignored by the great steam engineers.

In the present case, so far as can be seen by a cursory examination of this little work, it is what is wanted, and the author has come down from his technical pedestal to show, in the plainest manner, what a heat engine of the steam type is, how it operates, how it is constructed, and the principles in each case. In doing this he has dealt with all quantities arithmetically, in the plainest manner, and at the end given an appendix embracing questions covering the subject matter which has preceded.

The book is written by the Professor of Mechanical Engineering in the Sheffield Technical School, England. Published by Longmans, Green & Co., and sold here by Messrs. Osborn and Alexander for one dollar, which seems an absurdly low price for a technical book of the kind, with 200 pages of matter.

Report of the Postmaster General.

We are favored with a copy of this Report, which indicates an intense and extensive activity in the department which may result in reforms or progress, and, in some cases, may not.

It is the most remarkable example of personality on the part of a department chief that has appeared, and, in that respect, not improved. A pronoun of the first person is common, but not necessary at the beginning of documents of the kind, but to occur nine times on the first half page, and copiously thereafter, greatly impairs the dignity of such documents. In some departments of the Australian government the reports are not signed by the personal names of the officers even. For example, that on mines in Victoria, is signed only officially by the "Inspector of Mines." Why it is that people will not write in the third person, especially in official literature, is past finding out.

The subject matter of the report, aside from this blemish, and the farther one of a newspaper style throughout, is a full and complete presentation of the year's business. The section on ocean subsidies borders on the humorous when we consider the extent of the scheme and the outcome of it; however, the Postmaster General is not to be blamed for not preventing collusion which obviously existed in the bids. The report is illustrated with numerous fine plates.

Mineral Statistics for 1891.

The *Engineering and Mining Journal* has this year, as has been its custom heretofore, but in a still more comprehensive way, compiled a full report of mineral statistics for the United States and foreign countries, and has in its issue of January 2, 1892, presented a mass of reliable matter such as is not often collected and collated by the enterprise of a serial journal. The contributions are drawn from many sources, and represent an amount of expense and labor that reflects much credit on the Journal's management.

What to write as a proper notice of this statistical issue one can scarcely decide. There is a surfeit of material and a paucity of space, and the best that can be done is to quote here and there such facts and quantities as are supposed to have most interest to our readers.

Of the total mineral product of the United States it is said:

"The mineral industry of the United States has grown from the modest proportions of twenty-seven years ago to the point where its products are now valued at about $1,000-000,000 a year. It is not surprising, therefore, that those who have brought about this marvelous progress, and who have attained unparalleled success, should indeed be the most skillful men living in the practice of their arts."

Gold and silver are set down as follows:

"The output of gold is increasing, but in the absence of full returns we place it in 1891 at approximately 1,620,000 ounces, or $33,250,000, an increase of 312,000 ounces. The output of silver has increased much more rapidly, and we estimate, in the absence of full returns, that it amounted in 1891 to 58,000,000 ounces, the coining value of which would be $74,820,000."

Aluminium occupies this year a considerable section. The uses of the metal are widening all the time, but an impediment to any stable use exists in the fluctuation of prices from 75 cents to $1.50 per pound. At present the price seems settled at 90 cents a pound in this country, and at 50 to 60 cents a pound in Germany. The metal is procured mainly from cryolite brought from Greenland, in Danish America, but also from bauxite found in several of the Southern States.

Of copper, it is stated that the United States produced 43 per cent. of the world's supply, and, in 1891, 292,620,000 pounds. Of this quantity the Lake Superior district supplied 109,370,000 pounds; Montana, 113,-200,000 pounds; Arizona, 39,700,000 pounds; Colorado, 7,000,000 pounds, and California 3,750,000 pounds; a gain in this State of about 2,000,000 pounds over 1890.

In September, 1864, Lake Superior copper was 50 cents a pound, now it is 12½ to 15 cents.

In the section devoted to iron and steel we find the following:

"The production of steel rails, according to figures we have received from the Rail Makers' Association, is estimated at 1,090,000 tons, as compared with 2,095,996 tons in 1890, a decrease of over 1,000,000 tons, or nearly 50 per cent. How much of this decrease was due to the necessity of the railways to postpone purchasing, on account of stringency of their finances, and how much to their unwillingness to pay the pool price of $30.00 per ton, may be left to conjecture."

The petroleum interest is an enormous one in this country. The exports alone were in 1891, 605,183,605 gals., valued at $41,474,135. Of the product of this year it is said:

"The production of petroleum in the United States in 1890 was 45,000,000 barrels, valued at $35,000,000, against 35,163,513 barrels, valued at $26,963,340, in 1889. The production in 1891 has again shown a great increase, due in considerable part to the phenomenal McDonald field of Pennsylvania. The average daily runs of the Pennsylvania, New York, Eastern Ohio, and Northern West Virginia fields have been as follows: January, 90,673 barrels; February, 84,216; March, 79,346; April, 84,320; May, 78,821; June, 81,946; July, 79,927; August, 86,101; September, 97,981; October, 117,855; November, 128,444. In December the production of the McDonald field showed a falling off, but the total output of the Pennsylvania, New York, Eastern Ohio, and Northern West Virginia region in 1891, has probably been very close to 34,250,000 barrels."

Precious stones are included in the statistics, and the following respecting the South African mines is astonishing:

"Forty million carats of diamonds, weighing over nine tons, have been found in South Africa. In the rough their aggregate value was $250,000,000, which is more than the entire diamond yield of the world during the last two centuries. Of the whole production, perhaps 8 per cent. are of the first water, 12 per cent. of the second, and 25 per cent. of the third, while the remaining 42 per cent. is known as boart."

The Cajalco tin mine in San Bernardino County, in this State, is the only producing tin mine listed in this country, and is set down for 123,366 pounds in 1891, representing in value $24,673. The imports of block tin for 1890 were $6,896,645, and of plates, $21,923,754, or a total of $28,793,399.

In a technical way there is a good deal of interest, and most remarkable is the following respecting the pneumatic transmission of power:

"The stimulus given pneumatic engineers by the developments in electricity, has resulted in useful improvements in compressed air appliances. The air compressor has been improved on economical lines, even to the extent of a combination of the best Corliss engine practice, with compound air cylinders. Compressed air has been produced and delivered in the engine room with an efficiency above 90 per cent. The great loss suffered by shrinkage of volume through reduction in temperature is in great measure restored by various systems of reheating. It has been found that with a small amount of coal burned either externally or internally, the compressed air is heated and expanded so that with the same pressure an equal amount of work may be accomplished with less volume of air. Reheating compressed air has not received the attention it deserves. This is especially true in America, for the system of reheating employed in Paris, Birmingham and elsewhere, has been the means by which it has been practicable to economically supply large volumes of compressed air power great distances from the generating station. Reheating by electricity promises to serve a useful purpose, owing to the absence of combustion, the simplicity of the apparatus, and the fact that it is possible to convert electricity into heat unit for unit."

There is something not understandable in the above, if we consider that counter heating is not new in pneumatic transmission, and that the cost and expense of reheating agents and apparatus have generally balanced any gain in efficiency.

Arithmetic of Electricity.

BY T. O'CONOR SLOANE.

In the preface to this book the author says:

"In the following work the problems of electrical engineering and practical operations are investigated on an arithmetical basis. It is believed that such treatment gives the work actual value in the analytical sense, as it necessitates an explanation of each problem, while the adaptability of arithmetic to readers who do not care to use algebra will make this volume more widely available."

This remark indicates completely the aim in view, and while we do not believe that arithmetical computations are short or adaptable, there is to be considered the fact that the greater share of people do not understand or apply algebraic methods, and compute arithmetically. The book will, therefore, be acceptable to a majority of those who study electrical science in either a professional or amateur way. At first we construed the work as an elementary one, and hoped we had at last something more complete in that way than any that have preceded, but the computations, while they may not extend to the more obscure laws of electricity, are wide enough to cover all that is comprehended in existing practice.

The book is sent by Messrs. Osborn & Alexander, and is sold by them for $1.00

Patent Commissions Decisions.

Ex parte Nickola, November 27, 1891. Report of December 8, 1891.

THE RIGHTS OF A PATENTEE.

The Commissioner of Patents, in a recent decision, brings out very forcibly a principle of patent law and patent rights that is often overlooked, and not infrequently misunderstood, namely, that there is no natural right in an invention, only the right by statute, and not in common law. In other words, a patent is a grant by grace, and a patentee only within reasonable limits can control or determine the title of his invention. Further that the grant is one of conditions, and the conditions are imposed by the government and may be varied or changed within the limits of the Acts of Congress relating to patents.

These are not the Commissioner's words, but the gist of them, and bearing on a matter very imperfectly understood. Of course, if one follows back through that tedious old history of the statute of monopolies, in England, that prefaces all their literature on the subject, and out of which has been evolved our patent laws, they will gain therefrom the idea of a "grant," a conceded favor of the crown or government for meritorious effort; still this is not wholly applicable to modern laws and practice which, in a sense, makes a patent right a compact or agreement between the inventor and his government, wherein both sides have rights, even before a patent has been allowed.

Commissioner Simmonds could, with advantage, have extended his remarks in connection with the case.

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TECHNICAL SOCIETY OF THE PACIFIC COAST.

SAN FRANCISCO, CALIFORNIA.

INSTITUTED APRIL, 1884.

TRANSACTIONS.

(VOLUME IX. No. 1.)

NOTE.—This Society is not responsible, as a body, for the statements and opinions advanced in any of its contributed publications.

THE COMMERCE OF SAN FRANCISCO.

No. II.

BY GEORGE W. DICKIE, MEM. TECH. SOC.

[Read Jan. 7, 1892.]

The Secretary, on behalf of the Technical Society, having written me to ascertain if I would be willing to read and discuss before you my recent publication on the "Commerce of San Francisco," I suggested that the pamphlet having already received some attention from the newspapers and the merchants, it would be better for me to assist the further discussion of this important subject by meeting the various objections and criticisms that have been sent me direct, or have appeared in the press.

In order to clear the atmosphere of anything personal, and enable us to meet the technical difficulties that have been raised to the establishment of a direct ocean steamship line from this port to New York and Liverpool, in their proper order, I will dispose first of the objections that have been raised against the parentage of this scheme. Suspicion lurks in some quarters, because the proposition for a steamship line comes from an engineer and a shipbuilder interested in a company which is supposed by these objectors to be backed by the railroad monopoly. If San Francisco desires an outlet for her products, and an entrance for her imports by her own Golden Gate, who are most likely to give sound advice as to the best instruments by which this desired result is to be accomplished? Is it not those men who have given a life study to problems involved in the successful production of a modern ocean steamship?

The most successful steamship lines are those which keep on very intimate terms with the shipbuilder. If we want to dress well we take advice from our tailor in regard to the style of dress that will best suit us. If we want to erect a great building, that will be an honor to the City, we consult an architect who has had experience, and we carefully study the plans he proposes. So if the merchants of this City desire to make it the entry port for the western side of the United States, it can only be done by building a line of modern freight steamships expressly built for the special requirements of the trade, and, to do this, you need advice from your shipbuilders and engineers, so that, I think, we may take it for granted that the County Line comes from a poor, but honest and industrious parent.

In regard to the suspicion as to the place of its birth, it was natural for the newspapers to link my name with that of the Union Iron Works, although I expressly stated in my pamphlet that my work was that of an individual only. Nor need any suspicion be engendered on that account. Any statement made as to the connection of any of the Southern Pacific railroad people with the Union Iron Works Company has no foundation in fact. If the Union Iron Works has secured a good standing among the business concerns of this Coast, and among the shipbuilders of this country, it has not been by any backing from the outside, but is the result entirely of hard work and honest endeavor on the part of the Messrs. Scott and their associates.

Now, we will devote our attention to the "County Line," and why such ships were proposed. We will consider first the ships themselves, and second, the operating of them.

The question has been raised, both by letter and in the newspapers, why these vessels are proposed of such a size? In answering this question, I will not be tempted into discussing the steamship proposition of The Johnson-Locke Mercantile Company further than to notice one technical point, that has been presented in such a way as might lead to a misunderstanding. Having gone carefully through the specifications of their proposed vessel, I would not be justified in letting it pass unnoticed. I refer to the carrying capacity. Mr. Johnson (whom, by the way, I have not met) gives the carrying capacity of the vessel he proposes at 4,000 tons. Now the dimensions of the vessel, as specified, give a total dead weight carrying capacity, from the shipbuilder's light line, that is the flotation line as the vessel leaves the builder's hands, to the deep load summer draught line allowed by Lloyds, of 4,180 tons, from this must be deducted sea stores of all kinds, dunnage, and coal for the voyage, this will reduce the cargo capacity, for dead weight freight, to about 3,500 tons. This statement is made in case it might be asked why there should be such a difference between the dimensions of a vessel to carry 6,000 tons and those of one to carry 4,000 tons, and for no other reason.

If our merchants do not at present want the "County Line" I trust they will help the Johnson-Locke Company. My purpose was to present to the merchants an outline plan of a vessel that would make regular and reasonably fast trips, with every appliance for the rapid handling of general freight, in fact a fast freight ship of the most modern type.

Ten years ago I advocated first-class freight steamships for this business, and this is the original plan made at that time, the only change I have made is to increase the indicated horse power by 500, and adding 1 foot 6 inches to the beam. At that time this plan was considered too far ahead of existing types of freight steamships, the transportation of freight on the Atlantic was then, for the most part, done by vessels carrying passengers, or by old passenger vessels that had become unfit for the higher class of work.

The Monarch Line has built some special freight steamships carrying about 4,000 tons; the cost of transportation was reduced, the great lines had to build special fast freight ships to enable them to keep in the business, so that now they have grown to about the dimensions I proposed for the San Francisco, New York and Liverpool trade.

Let me instance the development of the fast freight ships of the Oceanic Steam Navigation Co.'s ships, that is the White Star Line. I take this line because of their intimate connection with one of the most progressive shipbuilding firms in the world, Harlan & Wolff, of Belfast. In 1882 this Company felt the necessity of providing special freight vessels, and Harlan & Wolff were ordered to produce two vessels to carry 5,000 tons dead weight cargo, besides fuel, stores, etc. The result was the *Doric* and *Ionic*, both of which went into service in 1883, and are still in the service, and average nine round trips a year. The dimensions of these vessels are, length 440 feet, beam 44 feet, depth 31 feet 6 inches.

These vessels have the ordinary compound engines, and on that account burn more fuel than those of a later date. In 1887, Harlan & Wolff built another special freight vessel for the White Star Line—the

Cufic. In this vessel the only change in the dimensions made was adding one foot to the beam, making it 45 feet instead of 44. The engines, however, are triple expansion. This vessel carries 5,600 tons dead weight freight, less coal being required than in the older boats. In 1890, they built another boat for the same company. This vessel, the *Nomadic*, which commenced running about the middle of 1891, makes her trips in ten days; carries 6,800 tons dead weight freight, and is of the following dimensions: Length, 461 feet; beam, 49 feet; depth, 32 feet. This vessel makes 11½ knots, loaded, on 33 tons of coal per day. Compare the dimensions of this vessel with those of the *County of Contra Costa*, or those of the ship proposed ten years ago, and it will be observed that they are almost identical, so that what was then considered too far in advance, is now only abreast of the best practice.

In some communications to me, the rig of the proposed vessel has been objected to as being too heavy. Rapid and economical handling of freight is of great importance in a vessel of this character, and to be rapid it must be handled from all compartments at once. We have eight independent holds, and five masts are necessary to provide cargo booms for each hatch. To be economical, it must be handled by the ship's own tackle, and I have provided for its being so handled.

In regard to the sail power, the sail area relative to the flotation area of the vessel is about the same as that of the *City of Pekin*. When preparing the earlier plan for this vessel, I had some talk, in regard to sail power, with the late Captain Berry, then commanding the *City of Pekin*, and inquired how it was that he managed to make so good time with such a small developed horse power. He said that he never let any wind slip past his ship without getting some horse power out of it. Mr. Forsythe, who sailed as chief engineer with Captain Berry, will be able to tell us how the sails were used. It was in the hope that the class of captains to which Berry belonged were still on deck that the *County of Contra Costa* is shown square rigged on four masts.

The question has been asked: Why have a spar-decked vessel which is not usual in freight steamships, and adds to the register tonnage, and why carry all bulkheads to the spar deck?

In providing a spar deck, the first object was to provide ample space for a large amount of light freight, such a dried fruits, wool, etc., which must be kept dry, and must also be ventilated. It also gives the ship a good free board, enabling work to be done on deck with some degree of comfort. Carrying the bulkheads intact to the spar deck, enables different classes of light freight to be kept separate. One kind might taint another if not separated by air-tight bulkheads. In case of fire, water can be used on one part of the cargo without any damage to another. Compartments can also be prepared for cold storage, if necessary. Shippers can secure independent compartments on certain decks for their own freight, and have it subject to a certain treatment on the voyage. The advantages of this arrangement will at once occur to shippers whose goods must not be subjected to the possibility of taint from other materials while on ship board.

The possibility of making the voyage in the time stated, and on the fuel provided, has been questioned. One evening newspaper, in an article published on the 26th of last month, takes, for an example, the case of the *Alameda*, which made the voyage from New York, without any stoppage, in 59 days, and this vessel averaged 13 knots per hour, and asks, triumphantly, how the *County of Contra Costa* is going to cover the same distance in 50 days, making 11 knots? Now, this party who demolishes my figures so cleverly, evidently knows it all by heart without any figuring; he deals with known facts, and you know that there is only one thing more misleading than figures, and that is facts. Now, here are two facts stated: 59 days and 13 knots, that is 312 knots per day, and 59 days at that rate would be 18,408 knots, that makes some trouble about these facts. If we take the fact of 59 days and the true distance, then the average speed was $9\frac{2}{10}$ knots per hour; if we take the other fact of 13 knots, then the time was 41 days and 16 hours. This writer, having disposed of my figures with his facts and, as he says, having shown me wrong in one item, concludes I must be wrong in all. We will not dismiss him in that way, but will refer to him again as occasion requires.

As an instance of what may be expected on a long voyage like this, with a ship specially designed for the purpose, I will give the first voyage out of the new freight steamship *Tekoa*, just built by Gray, of West Hartlepool, for the New Zealand Shipping Company, to run between London and Auckland. (Imagine little Auckland having ships that San Francisco can't afford). This vessel is 469 feet long, 49 feet 3 inches beam, and 33 feet deep; engines triple expansion, 27″ and 43″ and 72″×45″ stroke. Compare this ship and engines with the *County of Contra Costa*, and see how closely they approximate to each other.

This vessel left London a little over three months ago with 6,250 tons of dead weight freight, and 1,400 tons of coal in the bunkers, steamed 12,059 knots without any stop whatever in $50\frac{9}{10}$ days; average speed $9\frac{87}{100}$ knots per hour; coal consumed $1,081\frac{3}{10}$ tons, or $21\frac{1}{4}$ tons per day. This is a splendid result in fuel, considerably better than I expected to do in the *County of Contra Costa*, and it shows that 50 days is not only a possible time for the voyage from here to New York or Liverpool, but for a modern ship it can be done at a very economical expenditure of fuel.

Having considered the first question, that relating to the ships themselves, we will now consider the second question, that of operating them. Can these vessels be operated with any degree of certainty on the total expense allowed in my estimate? None of the communications to me have questioned the expense, but the article already referred to, in an evening newspaper, appears to have some weight in certain quarters, and therefore requires to be answered.

The first question asked is "why has no allowance been made for insurance of hull?" The writer of this newspaper article has not dealt with my pamphlet as it is, but has it mixed up with another proposition on page 11, suggesting the method of ownership of the proposed vessel. I provide that each owner can handle his own share as it suits him, can dispose of it as he pleases, can insure it or carry the risk as he sees fit, and on page 15 in stating that the amount divided would equal about 24 per cent. per annum, it is also given about 6 per cent. less to owners who insure. The question of time to make a voyage has already been noticed.

The next question raised is the time allowed for loading and unloading. The reference that this writer makes to time in way ports need not be considered, as no mention is made of way ports in the pamphlet. My proposition was for a direct line, but should there be business for way ports the time required at such ports would be added to the 50 days at sea and deducted from the 50 days in ports.

Our friend figures that on a round voyage, carrying 6,000 tons each way, 18,000 tons must be handled, and I forgot that fact for I had calculated on having to handle 24,000 tons. We will not discuss this question with the stevedores at present, but will refer to the time taken in port by similar vessels, referring again to the trans-Atlantic new freight steamer the *Nomadic*. I find that this vessel makes a complete round trip in 40 days; 22 days at sea and 9 days in port at each end, and carries 6,800 tons cargo. Here is 27,200 tons of freight handled in 18 days, and the "County Line" people cannot handle 24,000 tons in 50 days.

If this writer had cared to inquire around our own docks he could have obtained some facts on handling freight not quite in accord with his conclusions. The Pacific Mail Line ships from this port to China, are near the size of vessel we propose, and being also passenger vessels, are very poorly adapted for handling freight, yet if these vessels are on schedule time they have but 15 days in port to discharge and load coal, and do any repairs that may be required, and when occasion requires, as in the last trip of the *City of Pekin*, on account of going into quarantine, it can be done in half the time. The Occidental and Oriental chartered vessels, belonging to the White Star Line, in the same trade with this port and China, if they are on time, have 16 days in port, and as to going like clock work (as this writer seems to think outside of the possibilities), the White Star steamers, running from here to China, do run like clock-work, none of them having missed a sailing day for years.

The next question raised is that of port charges. Nothing is allowed, it is said, for loading and discharging. The amount to be paid for labor under this head was included partly under the head of port charges and partly under the head of wages. It will be observed that the full crew is maintained during the whole time in port, and provision account is also for the full force the full time. The cargo would be handled as it is on all such vessels, by the ship's own appliances, under charge of the ship's crew, outside help being engaged for breaking out and stowing cargo. If the crew leave the vessel more help would be required outside, but the wages bill on the ship would be less, and less provisions would be consumed; $1,400 was the amount allowed for outside help in handling freight in port. The New York freight steamers of the highest class allow 8 cents per ton for this work. I have allowed 12 cents, which would allow 16 cents at San Francisco and 8 cents at New York. Regarding the wharfage at San Francisco, this writer places it at $1,749.75. Now the per diem dockage of a vessel in this harbor is $4.00 for the first 200 tons, and ¾ of a cent for each additional *net* register ton. Vessels lying idle, or taking in cargo, are subject to only half rates. Our vessel would be 8 days subject to full rates, and 17 days subject to half rates, that is if the line could not lease wharf accommodation.

The net register tonnage, according to the plans, would be about 3,800. That would make the full rate dockage $31.00 per day; 8

days equals $248.00; 17 days, at half rate, equals $263.50, or a total dockage bill of $511.50; this leaves $1,088.50 for pilotage, the service of a tug, if necessary, and such things as would not be classed as incidentals. The dry docking of the vessel, which I had provided for at the outward end of the voyage as a mere matter of modesty, is also questioned, the writer stating that I had provided $5,200 for port charges and dry docking at Liverpool. The actual figures given in my estimate are $5,800.00. The intention was to use white zinc and tallow for the bottom. Material and labor for this work would cost in Liverpool $550.00, in San Francisco, $850.00. The dock dues for two days in Liverpool would be $1,392.00. Dock dues for two days, at present rates in San Francisco, would be $2,320.00. $2,800.00 having been allowed for docking and painting in Liverpool, deduct the cost of labor and material in San Francisco, leaves $1,950.00 for dock dues, should the vessel be docked here. Ten ships, docked once in five months each, would be 24 dockages, making $46,800.00 a year for dock dues.

The California dry dock people, I think, would be willing to contract now for the use of their dock at such rates. If an Atlantic freight steamship, say the *Nomadic*, incurred port charges equal to what I have allowed for the *County of Contra Costra*, it would equal $1.77 per ton of freight she carried, and this comes very near to equaling the rate at which she carries freight. In fact, I had made my estimate high to be perfectly safe.

There are other points brought up in the article referred to, which is really a very clever presentation of the objector's side of the case. He ingeniously works in the shippers' insurance on the goods shipped as part of the operating expenses of the ship. If his argument were for a higher rate of freight by rail than by sea, his point would be well taken, except for freight that has to cross the Atlantic before going on the rail, as the railway companies insure the freight while in their hands—the steamship owner does not.

Next the revenue of the County Line is questioned. According to this writer the competition is to be, not with rail freight but with the sailing vessel, and yet he advocates a competing railroad to relieve the distress of our merchants. Is this new railroad also to compete with the sailing ships? He says "dry goods merchants must have their goods from Europe in as quick time as ocean greyhounds and fast railway freight trains can bring them hither." Again he says "when the steamer arrives here they would have to wait a week or two until their goods were brought up out of the hold.'' Let us investigate this poetical statement a little. How is it that this merchant who is in such a hurry for his goods, gets them out of the same kind of a ship's hold in New York, without any loss of time, while the same operation takes one or two weeks here? More than that, he generally ships from New York by the Sunset Route, so the merchant who is in such a hurry, according to this writer, must wait two weeks to get his goods out of the ship's hold in New York, ship them into another vessel, which, according to this authority, must be ten days loading, for they take 4,000 tons, then another ten days again to get them out of the ship at New Orleans before they get on to his railway.

Again, he says: ''The merchants cannot afford to run the risk of almost certain delay in the voyage by the Straits of Magellan. They, with the fine leather merchants, with carpet dealers, even the hardware men, in many kinds of hardware, cannot afford to run the risk of damage by sea. For however closely a vessel may be constructed, the goods in the hold are sure to be damaged to a certain extent by leakage.'' This is a sad commentary on the ability of our ship builders to construct ships that will keep cargoes dry, yet these very dry goods merchants, leather merchants, carpet merchants, and even the hardware men, are just the men we want to carry freight for at $10.00 per ton, and they are not so much afraid of salt water either, for they ship at Havre and Liverpool on fine freight steamships like the ''County Line'' across the stormy North Atlantic, where their decks are often covered by seas all the way across, and ship them again on another steamship to New Orleans, and all without damage by water, and at from four to six times the cost at which it can be done by the ''County Line.''

Our ships might have to carry some classes of freight at five to six dollars per ton, but the freight that is now crushed by railroad rates, and that must be moved quicker than the sailing ship can do it, is just the freight that can afford to pay good steamship rates. As it must take the same time to get goods into or out of any two ships of the same character, and each fitted with the same facilities for handling freight, the question will present itself to the merchant something like this: To import goods from Europe by the present arrangements the time will be: 3 days to load, 11 days to cross the Atlantic in one of the first-class freight steamships; 4 days to discharge in New York; 2 days to load on Sunset steamer; 18 days from New York to San Francisco, and 1 day for delivery; total, 39 days—as the shortest possible time. To ship by the County Line would be: 3 days to load; 50 days to San Francisco; 4 days to deliver; total, 57 days. Now, if the difference between 130 days by sail and 57 days by steamship is not worth any difference in freight rate, why should the difference between 130 days by sail, and 39 days of steamship and rail be worth ten times the rate of freight?

A correspondent writes me that while the steamship line would be a present relief to the commerce of San Francisco, yet the salvation of the San Francisco merchant can only come with the completion of a canal which would cut the steamship time down to 27 days. While my correspondent is right, we must remember that if the means were already secured to construct the canal, it would be ten years before one of our steamships could pass through. We have already seen that the ships we propose are similar to the best types of freight steamships, for shorter routes, so that when the time comes when a steamship can go through the canal, the "County Line" will be as suitable for the business as anything that floats.

I have not exhausted this subject by any means, nor have I touched on all points that have been brought out in connection with the discussion that has been going on in the newspapers, but I have said enough to bring this subject properly before the Society, and draw from those present, who are interested, such an expression of opinion as will clear up many points on which the public are not very well informed. I trust the discussion will be without reserve, as I understand the Society makes this an open night, non-members having a right to take part.

After reading the paper, Mr. Dickie added the following:

"Some time ago in talking with a ship captain about the different ports for sailing vessels, he said that San Francisco was about the only port that was left unravished by steamships. I asked 'what is the reason San Francisco has been left out?' He replied 'I don't know, unless it be that the shippers and the merchants of San Francisco have not found out yet that ships are propelled by steam. If they ever find out that ships are propelled by steam our business is gone.'" Mr. Dickie added he would be glad to receive questions and criticisms from both members and non-members.

DISCUSSION.

Mr. Manson.—"Mr. President, I think we owe a good deal to Mr. Dickie for bringing up this question at this particular time. The last time this Society met in this hall one of the naval officers of the United States Navy pointed out to the Society, and to this community, the advantages to be derived from the construction of the Nicaragua Canal. Mr. Dickie touched on that, and showed the importance of San Francisco owning and operating, for San Francisco, her own ships. Ninety per cent. of the vessels that come to this port are not run for San Francisco, but simply to get as much out of our merchants as they can, just as the railroads do. We might as well understand the fact that they are not going to reduce rates until the merchants themselves get together and force them to do so. I would like to see a railroad running out of Chicago attempt to discriminate against the Chicago merchants; Chicago would have the railroad in the hands of a receiver in no time. The Board of Trade and other bodies of citizens would not allow that railroad to exist.

Now the Suez Canal, the Panama Canal, or the Nicaragua Canal, are not going to do us any good unless we own the steamships that run to, and in the interest of San Francisco. We are here on the borders of an ocean with 80,000,000 of square miles of water, and the wealth around that ocean is untold, and we own no great line of steamers, not even a line of sailing vessels. We sit down here and prate about the benefits that a canal, constructed by somebody else, will give us through the ships of somebody else. I think Mr. Dickie has struck the nail as squarely on the head as he possibly can do, in calling attention to the fact that we want to own and operate our own steamships for our own interests."

CAPT. W. L. MERRY.—" Mr. President and Gentlemen: I did not come here to talk, but to listen. The subject is a very old one to me. I spent sixteen years of my life at sea, and for seven years I was in command of ocean steamers. They had side wheels, long stroke, and consequntly now are behind the age.

In the first place there is not the slightest doubt that steam carriage by sea is as cheap as any transportation known to commerce, and especially for short voyages the steamship can compete with sailing vessels. The steamers we are now commencing to build which run at a low rate of speed—about ten knots an hour, for the carrying trade, can compete with sailing vessels on long voyages.

As San Francisco is a sea port her development must come from the use of her sea board. It cannot be accomplished through the railways. They can approach only from one side, it is not a center with railroads reaching out in all directions.

An ordinary ship takes 3,000 tons of freight, and that will load 30 trains of 10 cars each.

Now this question of Mr. Dickie's is an interesting one, because it is a solution of the great need of San Francisco at the present time. Of course it will obtain its best results with a shorter trip through the canal. That will, no doubt, be the ultimate solution. At present, however, the route is the worst one of the world, because it is the longest route ; and, as I have said before, the longer the route the greater the disadvantage the steamship has to compete with. There is no voyage in the world, that I know of, that is harder on the steamship than from New York around Cape Horn to San Francisco, on account of its length, crossing the equator twice and passing through the heat of the tropics.

The pamphlet published by Mr. Dickie I have read with great interest. I differ from him in some respects, but in the main I agree with him. I, however, suggested to him that, according to my American ideas, I was in favor of a little more beam, and suggested twin screws, so that in case one should break down the other could keep the ship going.

I have another objection, and that is the ship's name. A ship was building up in Maine somewhere, and the Captain visited Boston to report to the owner how it was getting along, he reported that it was nearly ready to launch and asked that they select a name. The owners told him they wanted a short name, one that was easily spelled, pronounced and written, and any name that would meet these requirements would be satisfactory, and requested him to select one. When the captain came to Boston again he was asked what name he had given to the ship. He replied, 'I thought of all your requirements, and after thinking the matter all over I called it the *Ox*, you can't find anything better than that.' But this is not a part of the argument. I should select shorter names simply to save time. The ships are long enough without having such long names.

The question is one of great interest to San Francisco. But if you go to the merchant today and say to him, 'here is a steamer that will land your freight with reasonable certainty in 60 days, and the sailing ship will land your freight with less certainty in 130 days, how much more will you pay for the reduction in time and an increased certainty in delivery?' do you know that man will say very little. I have been astonished to see how little they would say. They appear to think that the saving of time and the additional certainty of delivery is a matter that does not incur a great deal of extra expense ; consequently they do not give the encouragement necessary for men to invest in anything of the sort. They are apparently oblivious to the fact that the saving in time and the greater certainty of delivery is a great factor.

From all that I can gather, the question at best is a very close one. I think a steamship line from here to New York, with modern steamships, could be made to pay 8 per cent. per annum on the cost of vessels and operating expenses.

According to the laws of this State vessels registered here are taxed their full value. New York has no laws of this kind, and in Massachusetts if the ship earns nothing she pays nothing. Here a ship worth $1,000,000 is taxed $27,500 a year. If you had them here you would register them in New York and Boston to avoid that taxation. The policy of this country has been to damn the shipping industry and foster railroads. When I was a boy we were a maritime nation. England is a maritime nation, but without her ships she would be nowhere. We are a great country without ships, consequently we do not depend upon ships as I think we ought to for our own benefit and our own advantage. But San Francisco is not so much to blame; generally money can be better employed than in shipping, it can find better investment. When I was a boy everything was done to build up American commerce. We had all kinds of legislation for the encouragement of shipping. We have stopped encouraging shipping in any shape, and then we ask why we have no ships. On the contrary we legislate for railroads, and give them enormous land grants. Until these conditions are changed we will never have successful shipping.

I will be delighted to have San Francisco take up this question, but until the voyage is shortened by a canal there can be no large fortunes made in this direction, in my opinion. I think by economical management there might be a return of 6 or 8 per cent. In the main I am in sympathy with the ideas of the speaker."

Capt. Goodall.—"I did not come here to address the Technical Society; I believe rather in a practical operation, and the technicalities I am disposed to omit. Not being sufficiently acquainted with these I leave them to the wise engineers, who consider these matters at their leisure, and make a very fine effort when they tell us about them.

I want to lay Mr. Dickie's plan on the shelf, so far as the Liverpool proposition is concerned. If it is so practical to run steamers, such as he has planned, to Liverpool, there would be no difficulty in the way of English people running their tramps here at once. They have acres and acres of vessels lying still, waiting for something to do. (They had when I was last in Liverpool, and I think they have at the present time.) They have shops and shops, boiler shops and machine shops, and shipyards. They want business of this kind, they want ships to build, and they will build them for about half what Mr. Dickie proposes to charge for building the same ship. When they get them built they will run them for about 60 per cent. of what they can be run under the American flag, and owned in San Francisco. An English ship with an English crew, and English living, black bread, barley soup, and mahogany for meat differs from an American ship with condensed milk, fresh butter, and mince pie. It soon amounts to a difference of 60 and 100 per cent. Therefore I say it is impossible that Mr. Dickie's ships can run to Liverpool and pay.

As to New York, that is a different proposition, but the question is whether the railroads would allow it to be done. The railroads have five tracks now running between this Coast and the East in some manner or other; therefore they have found it necessary to raise the freight. With more roads, and an increased number of officers and offices, they must have increased operating expenses; hence a higher rate of freight. They are not going to take their tracks up. They are insane on what they call the 'long haul.' They would rather haul a ton a hundred miles than twenty miles, just for the sake of having a 'long haul,' if they can get the same price for it. Mr. Huntington, in his letter in the *North American Review*, says the law regarding this matter of the 'long haul.' is unjust; that the railroads should be allowed to run the steamships off because they can go somewhere else to make a living when the railroads cannot. A railroad has to confine its business to its particular track. That is Mr. Huntington's theory, because he is a railroad man; my theory is that this should not be allowed, because I am a steamboat man. As soon as steamships reduce freights they will make a strong fight. They will do the best they can under the circumstances. Railroads are run to make money, exactly as you run your mercantile operations, the Union Iron Works, and everybody else carries on his business to make money. When the railroad has run your steamships off then the people will have to pay higher rates to make up the loss of the railroad during the competition.

One more proposition: I don't think Mr. Dickie can run the ship as cheap as he imagines. He knows how to *build* the ships, and build them very cheaply ; but I have had some experience in *running* his ships. He estimates, for engines of 2,200 horse power, a consumption of 1½ pounds of coal per hour per horse power. Now we had one of the finest ships that Mr. Dickie ever built, and it takes 2½ pounds of coal to the horse power per hour. We also had an engine made by him put into the steamer *George W. Elder*, which is somewhat smaller than those he proposes to build. She made a trip to Callao when there was trouble there, and she made 8¾ knots per hour, and burned 15¼ tons of coal in 24 hours. They were modern engines, which Mr. Dickie built or designed himself —a splendid piece of work ; as fine as can be made anywhere. I don't think his "County Line" could have any better. I don't see how he is to run these larger vessels at the rate of 10 or 11 knots an hour and carry 6,000 tons of cargo on his allowance of coal.

Mr. Dickie is a little behind in the number of miles from here to New York. We had three ships make the trip that averaged 13,600 miles coming through the Straits of Magellan. According to Mr. Dickie's figuring he would be about two days away from New York when he thinks he is there.

There is no doubt that Mr. Dickie is all right about the building ; he has money enough for that—$680,000. I own a little in the Union Iron Works, and I hope he will get one to build at that price, for then I would get my share of the profits.

Somebody else has written an article in the papers giving the cost and profits of smaller vessels than Mr. Dickie proposes. This writer puts down $220,000 as the cost of building a steamship carrying 4,000 tons, and running that ship on something like 14 tons of coal a day, and getting 10 knots an hour. It seems to me that is a hair-brained proposition, too. I think there is a mistake about this business, and I shall have to take issue with Mr. Dickie in the matter of running expenses."

W. L. Merry.—"There are one or two points that I cannot agree upon with Captain Goodall. In small steamers there is always a disadvantage in carrying freight as compared with larger ones.

As to the distance between here and New York, I have investigated that very thoroughly, it averaged through the Straits of Magellan, 13,560 or 13,580 miles. But these are nautical, not statute miles, which makes quite an essential difference.

The criticisms he has made by comparisons with the *George W. Elder* are hardly fair ; between this and the ship Mr. Dickie proposes to build there is an enormous difference in the type and character of freight it will carry, and in the tonnage. I have no doubt it would show a greater capacity and less use of coal. I don't think it is a fair comparison to make between these two classes of vessels."

CAPT. GOODALL.—"I made a reference to a brand new ship planned and built from bottom to top by Mr. Dickie, and what he does not know about building ships and engines no one knows. The little ship called the *Pomona* developed about 1,000 horse power, and burns 2½ pounds of coal to each. She makes about 13 knots an hour."

MR. DICKIE—"The main point made in this discussion, and it is a very important one, has been made by my venerable friend the Captain, in regard to the consumption of coal. Now I stated in my pamphlet that the fuel was first-class steam coal, that the estimate was based on Cardiff coal, and the price allowed that paid for Cardiff coal at both ends, delivered to the ship. Now other vessels of the same size as this ship are doing this work, and doing it every day on the fuel that I have proposed. The horse power requisite for the speed is 2,200 for a vessel carrying 6,000 tons of freight. Captain Goodall's vessel carrying 1,200 tons of freight requires 1,000 horse power, although a development of 700 horse power would give the same speed that I propose.

I am referring now to the *Pomona*, and the Captain's statement of the consumption of fuel on that vessel needs some explanation, otherwise this statement might be compared with the consumption on other vessels, and our reputation suffer in consequence. Having seen the Captain's computation of fuel burned, I am in a position to explain how he arrives at the result of 2½ pounds of coal burned per horse power developed.

The *Pomona*, running in the Eureka trade, averages 43 hours running time, that is from the time the captain gives the go ahead bell to the time he slows down at the other end the average time has been 21½ hours. Now, so much coal is placed on board for the round voyage for all purposes, this amount the Captain divides by 43 hours, and then by the horse power shown by the cards taken during the trip. Before he made his computation against the consumption per horse power of the engines, he should have deducted the fuel required to get up steam in San Francisco, the amount used in a donkey boiler, taking in freight, the amount used in the kitchen on the voyage up, the amount used in Eureka hoisting out and in freight, and getting up steam for the down trip, and the amount used in the kitchen on the way down. With these deductions he will find the consumption of even the poor quality he uses not more than 1¾ pounds per horse power per hour on the *Pomona;* the percentage used in ports where the voyage is less than one day is very great, and this case will not compare with that of a 50-day voyage. The power does not increase as the displacement, but with the skin resistance of the vessel—the wetted surface, and some other factors that enter into it.

Now I have stated in figures tonight the facts. Here are vessels crossing the Atlantic carrying the amount of freight I propose for these vessels, and they burn the amount of fuel I have allowed. Two of the larger vessels on the Atlantic, of the White Star Line, have developed a horse power for less than 1½ pounds of coal. It depends upon the kind of coal that is burned. Capt. Goodall knows that the kind of coal used in his vessels is not the same as would be used for an economical long ocean voyage. These vessels must have steam coal, Cardiff coal. With that kind of coal and the proper means for burning it, the consumption will be, in fact, less than what I have stated.

Regarding the distance the vessel would have to run, I was in error. I had assumed 13,060 nautical miles as the distance. That would make a difference of three eighths of a knot of speed in the vessel to make the time I have stated. But the amount of coal provided was sufficient for six days more voyage than the time given for the ship. The statement of power, and the statement of fuel consumed upon a freight steamer that has just made her first trip to Auckland, I know to be correct. Her consumption of coal was slightly under 1½ pounds in the development of horse power up to 1,700.

As to the certainty of long voyages, the Orient Steamship Co., whose ships run about the same distance, are very regular in their sailing days. The voyage to the Australian Colonies from England is nearly as long as the voyage around our continent by the Straits, but not as severe. The modern steamships can be made just as reliable as the railroad train. They are subject to accidents, but these accidents are not of so frequent occurrence as one would suppose, that is, in vessels that have been built expressly for the business.

Reference has been made to a vessel that came in here, for a few days, that made an exceedingly long trip around the Horn. That vessel is not fit for any kind of business. If we propose to carry freight from San Francisco to Europe or New York, or from these ports, in such vessels, we will meet with failure, and we can't do otherwise. The idea of cheap ships ever being employed in this traffic must be abandoned, for it will never succeed.

It has been stated here tonight that ships could be built in England for half the price I have stated. I happen to know the prices of several ships on the White Star Line. One of the steamers cost $584,000, and she is 20 feet shorter than the ship I propose. It has the same outlines and engines exactly. That vessel is employed between Liverpool and New York, and the average amount paid for freight carried in that vessel is less than $2.50.

Captain Goodall says these ships would be run out of the business by the railroads, who would reduce the freight. Well, this is one way of getting even with the railroads, if the railroads reduce the freights you have only to keep the steamships going to keep freights reduced.

There is a deeper question than that. No company can run at a loss except for a short time, or for a certain purpose; they cannot do it forever; the railroads must earn enough to pay running expenses. Now it takes the same amount of fuel to carry one ton a mile on the railroads in this country as it does to carry the same amount 20 miles on an ocean steamship of the latest make. Such are the statistics in England, and they have been compiled very carefully. Now it is simply a question of endurance. I hardly think it is possible that they can come under a cent a pound for freight and pay expenses. When the Sunset route was opened, the railroad people were going to carry the wheat that way to New Orleans, and ship from New Orleans to England at $10 a ton, and that is the freight I proposed for these vessels. The question is simply this, is $10 a ton reasonable for carrying goods from New York to San Francisco, or from England to San Francisco on 50 or 55 days' time? If that is a reasonable freight then the steamships can do it, and do it profitably. That is really the only question. The railroads cannot do it profitably at that price. If the fact of a few steamships would reduce the charges for freight on the railroads for all trans-continental freight, it would pay to keep them running even if they carried nothing. They could run opposition to Captain Goodall now and then, to keep up the status of the concern.

The cost of building ships and the cost of running them is a matter that can be brought down to figures, and the statement that a vessel of the size I propose can be built in England for $200,000, or $300,000, has no foundation in fact. We are not talking of tramp steamers, but of first-class freight steamships, and they do not compare with each other at all.

Captain Merry raises a question which I think the most important raised tonight. That we have to pay a large amount of the earnings of our steamships for taxes. Now this is a matter that lies entirely with the people themselves; they make the taxes; and if it is a good thing for San Francisco to have steamships, they can legislate to remove the tax on steamships.

Capt. Merry.—"I will state in that connection that the new Constitution stands in the way, for it says all property shall be taxed. It is a question of getting a new Constitution, and that is a very hard matter to do. I would be pleased to see it. It is now simply a matter of registering somewhere else. The Pacific Mail steamships are all registered in New York."

Mr. Dickie.—"I may state about the cost of ships for the U. S. Navy, now building here, that if the material for them were brought on steamships for $10 a ton from where it is manufactured, it would reduce the price of one of these vessels in San Francisco $46,000. That is the difference between carrying this freight by steamship and by rail. We are building a warship of 10,000 tons displacement for the U. S. Government; if the material that comes from the East for that vessel could be brought by sea in the time that I have stated, and at the rate of freight I have stated, on that one ship it would make a saving of $97,000. Now, there is money in this matter of carrying freight. It would pay to run a steamship to get the railroad people down to the same rates under these circumstances."

W. L. Merry.—"What do you consider the difference in cost in the building a first-class ship in Philadelphia compared with the cost of the same ship built at Liverpool. I see that Cramp says in an article in the *North American Review* that he can build as cheaply as in England."

Mr. Dickie.—"I understand him to mean that a ship of a special class he can build as cheaply as they can in England. They can build an English ship cheaper than we can. For instance, Elder & Co. can build an Elder ship cheaper than we. To build *the same* vessel cannot be done as cheaply here as there. The material and the labor cost about twice as much; the main difference is, the ship builder gets a larger profit in England than he gets here. There are ship builders and ship builders in England, and it is very difficult to predict what would be the price of a vessel. The White Star people have been offered between $600,000 and $700,000 for a vessel that has been running over 22 years, and it is almost as much as the vessel cost, and yet it could not be bought.

Vessels for special purposes are not cheaply built in England ; but vessels that are standard ships and built by the dozen by everybody, and where no reputation is involved in the building, and when they are lost no one asks who built them — such vessels are built very cheaply."

Capt. Goodall.—"What do you think of a ship constructed to carry both freight and passengers, and to stop at Callao, Valparaiso, and Rio Janeiro?"

Mr. Dickie.—"A ship carrying passengers as well as freight, and stopping at way ports, is a subject that is not in our programme tonight. That is a matter of steamship management more than steamship building. It is a question I have not sufficient knowledge of to give information that would be worth anything."

Capt. Goodall.—"In my opinion, that is the practical way to do the business. A large trade could be developed between these way ports at good prices, and if the railway people compete on the long route, the local business can keep the ships running."

Capt. Merry.—"I made several trips to Australia in sailing ships chartered by British merchants, and at that time that work was done by large clipper ships. That was along about 1859 or 1860. This business has now entirely left the sailing ships, and there are very few in that trade, the steamships have taken it away. That is more analogous to our ocean route than any other. The voyage is long, and a portion of it is tempestuous; but notwithstanding that fact the lines of steamers between Australia and England have absolutely run those sailing vessels off, and many are now hunting trade from San Francisco.

Another point I wish to mention is this: Mr. Huntington is a very astute man; he is probably one of the best financiers in railroading and one of the shrewdest operators that this country has produced. That man, when he saw he had to make a fight on overland traffic, notwithstanding he owned a railway from Newport to New Orleans, practically had his connection from Newport to New York, he bought out the Morgan line of steamships between New York and New Orleans, for the express purpose of making that fight and beating the overland railroads; and notwithstanding that route is attended with several difficulties, he has been able thereby to dictate the policy of the overland companies crossing the continent. When you come down to the basic fact, water transportation will always beat railways when time alone is not requisite. It is Nature's highway—it is God's highway; it requires no tracks; it is free to everybody, and when we consider how much greater the operating expenses of a railway are than running ships, we can see how difficult it will be for railways to compete. Water transportation will always beat the railways, provided there is an opportunity to put the ships on, and getting freight for them. I think that is a demonstrated fact.

I tell you, gentlemen, this is really the solution of the position of this port. It will never be a railway center, from the fact that we are at the end of a long haul, and can have railways only on one side of us. As a seaport we have great advantages at our command. Until this is made a seaport in the full acceptation of the term, San Francisco will never be what her locality should entitle her to be in future.''

DISCUSSION OF TOPICAL QUESTIONS.

[Held Dec. 4th, 1891. From stenographic report.]

The following question was submitted:

How can we account for the fact that machine work in San Francisco is, with few exceptions, not made to standard sizes?

Mr. Richards.—''I am qualified in one way to say something upon this subject, that of always having felt a great interest in it, and have never been able to discover a single reason why work in San Francisco should be made to no standard whatever, of any kind. As to giving you any light upon the subject, I have something to do with standard measures, but remarks upon that subject would hardly be speaking to the question.

To make use of a national standard would, in some parts of the world, increase the value of machinery ten per cent. In Sweden, for example, machinery not made to standard sizes would be reduced ten per cent. in value. I think the same is true in South and Central America, but am not so certain about it there. The commercial phase of this question is of particular importance. As to the mechanical part, there are none better able to discuss it than the Technical Society; not only a few, but a great number of its members. Perhaps Mr. Dickie will favor us with a statement of the facts as they exist.''

Mr. Dickie.—"There are some things in regard to measures that are not standard that can be explained. For instance, an inch board is seven eighths of an inch thick, and a two-inch board is one and three-fourth inches thick. The reason of this seems to be that the person who cuts up the timber expects to get so much out of it, and adjusts the sizes accordingly.

In regard to iron work the same rule prevails. Shafting has been made, as a rule in San Francisco, from merchant bars, and each shop, I believe, has a different gauge for shafting, and these are in a large degree dependent upon the opinions of the foreman of the shop.

Sometimes the standard has to be changed for shafting. I remember, eighteen years ago, of a very large shipment of bars for shafting from England to San Francisco, none of them would turn up to the gauges, and the gauges had to be made to suit the shafts. So it has gone on until we find that each shop has a sort of independent practice which prevails in these matters.

Why it continues now is a mystery; there is no necessity for it whatever. It is a source of infinite trouble, annoyance and confusion. Suppose that a Mexican firm sends here for a certain size of shafts, and they are sent there, and they are not to standard size, there is trouble about it. I think our company has a good many tons of shafting in Mexico that has never been paid for, because not of the size ordered.

If the manufacturers would come together in a right spirit, they could regulate this matter. The great difficulty is that if one shop adopts a standard, the other shops adopt something else; they are enemies to each other, and they are apt to injure each other whenever they can. There is an opinion that if you send out machinery that nobody else can fit parts to, it will come back to the same shop for repairs.

Except for shafting, and round work generally, I believe there is a sort of gauge system. Unfortunately, each shop has its own. Until the proprietors get closer to each other, and will consult pleasantly about matters in general, there is no help for us. The only way by which this can be brought about is a better feeling among the manufacturers. A society like ours can not dictate to them, or influence them very much to make their work of the same size. Until San Francisco gets out of her provincial ways, in more things than one, we will have to continue as we have been doing. Everything is governed here by "certain powers," not amenable to technical influences.

Then again, as long as customers will accept a false shop gauge, and irregular dimensions without demurring, and as long as they are satisfied with machines that fulfill their purposes without any reference to standard gauges or sizes, that long the present system will go on. There are but two ways by which change can be brought about, either the customers must insist upon certain rules and regulations in regard to gauges, or else proprietors of establishments that manufacture machinery must get together, compare notes, and establish something in common that all will receive."

MR. BEHR.—"How do you manage in your own work?"

A.—"In shafting, for example, I get the actual size of the shaft. The Eastern manufacturers advertise their shafting, and give the actual size to which it is turned, and do not state that a shaft is three inches which is actually two and seven eighths."

Q.—"Do you figure the decimal foot and inch on your work?"

A.—"No. I use the English system of measures, inasmuch as we have not the metric system in use."

MR. VISCHER.—"To what extent does variation of sizes exist in the shops?"

A.—"A three-inch shaft would not fit a hole bored in another shop. It would depend upon what shop it came from; but roughly speaking, perhaps by as much as one sixteenth of an inch."

Q.—"What uniformity would you expect in work of a specific size, coming from the same shop? Does that also have to do with the matter? If a uniform system were adopted would not the work itself be better and more accurate?"

A.—"In most of the shops a uniform system is adopted, so far as shafting is concerned; that is, they adhere to their size. They have gauges for shafting, and a shaft is finished to these sizes. A pulley ordered from the same shop would fit."

Q.—"There is no economic reason why a uniform standard should not be adopted, is there? Would a gauge suitable to one shop be equally as suitable to another as far as the two are concerned?"

A.—"Yes. But arbitrary gauges should not be adopted; that is, standard sizes should always be adhered to. Nowhere is there any strict adherence to gauges where heavy machinery is involved; it would not be possible. For instance, in the reaming of a very long hole for bolts and connecting rod; bolts, say three and one half feet in length, it will often occur that one of these holes has to be reamed slightly larger than the others, and it is absolutely necessary in order to bring things together. While the specifications might require that these things should be interchangeable, they are not strictly so made.'"

Q.—"At the same time the case you are stating now is not one of those which lies within the scope of your first remarks ? "

A.—" No. In the matter of shafting, and round forms generally, as they are used, and turned work, there is no reason why standard gauges should not be used. There need be no arbitrary sizes ; the standard gauge should be used as it is used for threads."

Q.—" To what extent is the more uniform practice carried out in the East ? "

A.—" The gauge system prevails quite generally among manufacturers of machines. It is not used so much in regard to the manufacture of engines as of machines. In machines used in textile manufactures, for instance, a gauge system is absolutely necessary. If we on the Pacific Coast should manufacture such machinery gauges will be *forced* into the machine shops. I doubt whether the gauge system is carried out so perfectly in this country as in Europe. Mr. Richards knows better than I in regard to that. I know that in flax machinery a change wheel coming from almost any of the European works would take its place on any machine that had been made within the last fifty years, and fit perfectly. It is a great advantage to have it that way. I think the interchangeable system is nowhere carried out as it is in that branch. For spinning long flax there are gear wheels extending up to hundreds, and you may take a frame made in Leeds, and a frame made in Scotland, and, I think, also in France, and the same change wheel can be used on all of them.

The system of gear wheel making, too, is much more perfect there ; not wheels that are cut, but those that are cast. I think one could give an order to Chambers for change wheels made by his machines to fit on a machine made by any other firm within a range of fifty years, and when received, it would fit in its place."

Mr. Richards.—" They do not make wheels in common foundries in England ; that is a wheelmaker's special business."

Mr. Behr.—"Are all the calendered shafts made to the same gauge ? "

A.—" They are made to a standard gauge, and very accurately."

Q.—" Do all manufacturers in England agree on the same standard ? "

A.—" Yes. It is a national standard gauge."

MR. VISCHER.—"Are you able to tell us through what agency the uniformity that exists in Europe was brought about?"

MR. DICKIE.—"I think, perhaps, through the agency of half a dozen of the earlier mechanics about the beginning of this century who established gauges, and were persistent in maintaining and preserving them. Perhaps Whitworth has had more to do in establishing gauges for England than any other man. Before his time I think Clement was the first to work systematically with gauges."

Q.—"In the early days of engineering in the United States were there not American manufacturers who used their efforts in that direction—Sellers, for instance?"

A.—"That was at a later date. Although Sellers has always had gauges of his own. I don't think he has ever made any effort to make gauges that would be generally applicable to the work of the country."

Q.—"Was not his influence sufficient to make other manufacturers adopt his gauges?"

A,—"No. The Sellers' thread has not been adopted."

MR. RICHARDS.—"The American Standard Gauge Works, in Wilmington, have produced more gauges than any other firm in this country, but have not written about it so much. The gauges supplied exceed one hundred thousand."

MR. DICKIE.—"In regard to measuring by touch, has there been any other method used in shops as practical?"

MR. RICHARDS.—"I think measuring by sight is only a laboratory process. I am so prejudiced about it that I am almost afraid to make any remarks. I dislike the whole scheme of visual readings. A machine has been made by Sir Joseph Whitworth by which the one millionth part of an inch can be ascertained. A visual reading cannot do that. In my opinion it is impracticable, except as a laboratory method. I am speaking strongly so as to provoke discussion."

MR. SWAIN.—"Watch factories are using, almost exclusively, the sight gauges."

MR. DICKIE.—"There is one difficulty about measuring by any kind of visual reading. Most any workman or mechanic can understand touch—he can feel, but it is a different matter when it comes to perception by sight; there is always the liability of mistake by reading a scale wrong; it requires some education. But a lathe man who is accustomed to calipering, can feel with wonderful accuracy; some are exceedingly expert. Now, for instance, we put liners into steam cylinders, and have to determine the fit required to put one in a cylinder under 80 tons pressure; we have our lathe men who can do this, and it will fit precisely in its place. That requires measurement that no sight reading that I can conceive of, would accomplish."

Mr. Swain.—It seems to me that one reason why western cities have failed to have a standard is because drills and reamers, and all standard tools used to do the work have been available in the Eastern States; but if a western shop wants to fit a piece of work the first thing done is to drill a hole and fit a piece into the hole. They go into the blacksmith's shop and have a drill hammered out to the nearest size that can be got from the scale, sometimes it is turned and sometimes ground on a stone, to fit the work ready to drill. But in the Eastern States you can go into a store and get standard drills and reamers. They have a better chance to attain standard work. It seems that a set of gauges are useless in a shop without having the means and tools also to do the work. In Palmer & Rey's shop we are using, almost exclusively, Richard's standard gauges, and we find them very satisfactory. We are using them in conjunction with the Morse reamers."

Q.—"In the armories, do they follow the standard gauge in minute measures?"

A.—"I think the original standard was obtained from Whitworth & Co., and duplicates made of varying degrees of accuracy. The cheaper ones were given out around the shop, while the better ones were kept in the different departments of the main office, and in the fitting of the gun parts every foreman has two gauges. One is an allowance for error, the other a small one, and the piece of work must be fitted so that it will not go through the small gauge, but must go through the larger one. In that kind of work a certain amount of error must necessarily be allowed, although the error in gun work is very slight because the pieces are small. As they increase in size the difficulty of duplicating is very much greater. Although one can have a standard gauge for boring a cylinder or anything else, it is difficult to keep a tool of such size that it will duplicate any number of them and keep absolutely to that standard."

The Elgin Watch Factory uses the metric system and sight gauges entirely, they are not dependent upon the condition of the workmen, that is, whether a man feels well or not in the morning. The difficulty of calipering a piece of work is this, the same man will caliper differently at different times. The sense of feeling varies. I think two cylinders held up to the light will show almost as fine an error by sight as can be found through the sense of touch."

Mr. Wood.—"I am not in the ranks of mechanical engineers, I am only a contractor. Still I have a profound appreciation for their work. Societies in the east, analogous to the Technical Society, have done a good deal toward establishing uniformity in some lines of work, and I do not see why they should not accomplish something in that direction. I believe it would be well for the officers of this Society to prepare a circular, worded in the technical lore of Mr. Dickie or Mr. Richards, or a committee including those members, and have these circulars distributed among the various shops in the city and among those directly interested in this matter, so as to get an expression of opinion from them, and the arguments from their point of view. I do not see why this Technical Society is not competent to draw their fire and to agitate the subject, and to keep it up until some uniformity is secured. I will say, as a representative of a contracting firm, that I would welcome most gladly a uniform standard in any work. Now, we have hardly a uniform standard in anything."

Mr. Dow.—" Unfortunately I am one of those manufacturers who have so many different gauges to contend with, or rather I did have them some six or seven years ago, so that I found it necessary to take a positive standard. I used the Brown & Sharpe system of gauges for all diameters up to 24 inches. I must say that in my own works I do not suffer any inconvenience. But I know, in general, the shops in this City do not do their work on the gauge system, and as a general rule such a system is very badly needed. I think the only plan is to do as Mr. Dickie says, get the proprietors together and work in harmony and good feeling."

Mr. Richards.—"There has been very little said about the economical part of the problem, the saving that may be effected by this system. I don't know that anybody is prepared to give any statistics about it, only by general observation. There is an economical problem lying at the bottom, in the matter of tools and cost of doing work."

Mr. Dickie.—"It is not so much in obtaining gauges and having them, as in the working thereof. Little mistakes are made and rectified, and machines go out without any record of these corrections, that makes a great deal of trouble—a thing is supposed to be made to a gauge when it is not. I believe that gauges in many kinds of work can make a saving of at least 60 per cent."

MR. BEHR.—"Mr. Richards spoke about machines manufactured for South America, and if made to a standard would sell more readily. I suppose it would be necessary to use the metric system, as in France and Germany, and all European countries where this system is used."

MR. DICKIE.—"All the work we have got from Krupp has the Whitworth threads, unless specially ordered otherwise. I noticed that the French specifications all call for Whitworth threads. In some work that we procured for the *San Francisco* we had to renew the screws after they were received here. So we are just as badly off with the work of other people as other people are with our own."

MR. RICHARDS.—"I was not aware that the English standard is used in France and Germany for threads. I suppose it is done for commercial expediency. In places like South America and distant parts of the world, the English have gone there first, and the measures generally had to conform to their standards."

REGULAR MEETING, FEBRUARY 5th, 1892.

PROCEEDINGS.

MINUTES.

The meeting was called to order at 8:30 P. M., by Mr. C. E. Grunsky, Chairman.

The minutes of the last regular meeting and of the annual meeting were read and approved.

The following new members, having been balloted for, were declared elected:

Theodore Wetzel, Supt. Derbec Mine......North Bloomfield, Cal.
L. C. Russel, Mechanical Engineer..........San Francisco, "
Frank H. Olmstead, Civil Engineer..............Riverside, "
Geo. P. Cramer, Surveyor, (Junior).... ....Seattle, Wash.
J. F. Morrow, Surveyor, (Junior)...........San Francisco, Cal.

The following names were proposed for membership and referred to the Board of Directors:

Bernard Bienenfeld, Civil Engineer, of San Francisco; proposed by Ross E. Browne, Frank Soulé, and Hermann Kower.

Conrad Eimbeck, Civil Engineer, of Guaymas, Mexico; proposed by Hubert Vischer, Luther Wagoner and Carl Stetefeldt.

D. C. Henny, Civil Engineer, of San Francisco; proposed by Hubert Vischer, Geo. F. Schild and John Richards.

Alexander M. Reynolds, Civil Engineer, of Seattle, Washin on; proposed by J. P. F. Kuhlmann, H. C. Behr and Otto von Geldern.

Arthur H. Sanborn, Ass't City Surveyor, San Francisco, proposed by H. D. Gates, Otto von Geldern and Geo. F. Schild.

Mr. N. S. Keith invited the members to visit his place of business to inspect a new electric drill. He stated that the time between 10 and 11 A. M. would be most suitable, during the coming week.

A communication from Mr. Luther Wagoner was read, in which he donated to the Society a complete set of Van Nostrand's *Engineering Magazine*, consisting of thirty-four bound volumes, and expressing the hope that similar donations would also be made by all who have the Society's welfare at heart.

The Secretary was instructed to communicate with Mr. Wagoner, and to express the appreciation of the members for this valuable gift.

Mr. D. C. Henny, Civil Engineer, then read an interesting paper, treating of "Water Pipes built of Wooden Staves," a subject comparatively new to the profession, which caused considerable discussion, entered into by a number of prominent members.

Two visitors, Prof. Marx, of the Leland Stanford, Jr. University, and Professor Kernot, of the University of Melbourne, Australia, also spoke briefly on the same subject.

(This paper, with its discussion, will be published in the next number of the Transactions.)

DISCUSSION OF TOPICAL QUESTIONS.

The topical question submitted for discussion was announced by the Chairman :

What is the effect of wind on the mean velocity of a river?

The Secretary then read the following communication from the author, Mr. D. E. Hughes, in order to incite general interest in the subject :

CONCERNING SURFACE SLOPE OF WATER, DUE TO WIND ; AND THE EFFECT OF IT ON THE MEAN VELOCITY OF A STREAM.

Not till after this question was proposed did the writer learn that anything would be required of him, or something easier would have been sought ; yet, in preference to retreating, this paper is offered, with the sole plea, however, that it may provoke discussion.

Wind imparts to water a nearly horizontal force, which, taken with gravity, furnishes a resultant out of plumb, thus causing a surface slope. This wind force is due to what, for want of a better name, is called fluid friction, and to a component of wind pressure on an oblique plane. This plane is furnished in the windward side of waves, by the inclination that the surface of the water has already attained, and, maybe, by virtue of a dip of the wind.

Fluid friction and wind pressure are both quite generally assumed to vary as the square of the velocity (v^2). Gravity on a column of water varies as the depth (d). If nothing more were taken into consideration, it would appear that the slope equals $k \frac{v^2}{d}$ where k is a constant.

Wind acts more on the upper portion of a body of water than it does lower down. In consequence of this, is there, in addition to the undertow of the waves, any under-current windward caused by super-elevation of the general surface at the leeward side? If so, then the above expression for slope must be diminished by what? Probably some function of depth, and velocity of the wind.

The writer does not deny that there is an underflow due to the existing differences of head, or, rather, to a tendency to a still greater difference ; but he thinks, without much investigation, however, that in case of shallow water, where viscosity and bed resistance are relatively great, the negative quantity, occasioned by the undercurrent, is small in comparison with the positive term, and, since wind slopes on water of considerable depths are trifling anyway, the opinion follows, that for most practical purposes the simpler formula will be sufficiently correct, if it is adjusted to water 4 feet deep and wind of 40 miles.

The coefficient required for this must be supplied from observation. An approximate one is deduced from the following imperfect data.

In the southern part of the *Colusa Basin*, which is a depression flanking the right bank of the Sacramento River, north of Grafton, there is an area about 9 miles long, which is very nearly level lengthwise, and practically bounded at the ends by levees. Its direction is that of the south wind, and "northers," which come there from a little east of south and west of north, respectively.

Last winter it was observed that a strong south wind raised the general surface of the water at the north end 6 inches on a stake some distance from the levee where the water, on a still day, was 4 feet deep.

The ground being level, the slope lengthwise of the trough was probably not quite uniform owing to change in depth caused by the slope, but the excess in the half where the depth of the water was diminished so nearly atoned the defect in the other half that the average for the whole was practically the same as that obtaining at the center, where the depth of 4 feet was not altered. The width of the water, averaging more than 3 miles, was not uniform ; but its figure was so nearly symmetrical, with respect to the mid-cross-section, that the depression of the surface at one end is assumed equal to the elevation at the other, or 6 inches, making a total fall of one foot in the length of 9 miles.

I do not know what the velocity of the wind was, but make the assumption (and the constant is at the mercy of it) that it was 40 miles per hour.

The levee on the north end of the 9-mile trough does not extend clear across, but turns to a northerly direction, leaving a channel west of it. Up this channel about 1½ miles, where the ground is a half-foot higher, another observer noted as follows : "Depth in calm a little less than four feet; surface depressed by strong north wind, 8 inches."

It may be noticed that the slope found, will, when reversed and extended 1½ miles, just fit this case.

These observations were not made with a view to their technical value, but are, nevertheless, trustworthy as far as they go.

I think that a little of that slope was borrowed from the tendency to a greater one in the shallower water along the sides, and that if the 4-foot water had been kept separate from the rest by parallel levees, the surface fall between them would not have exceeded one-tenth foot per mile. Putting this in the formula it becomes:

$$\text{Fall in feet per mile} = \frac{(\text{Velocity of wind in miles per hour.})^2}{4{,}000 \text{ times the depth in feet.}}$$

As before mentioned, this rule, even if the above data were correct, is right only for a 4-foot water and a 40-mile wind. For a less depth it does not give quite enough, while for deeper water it shows too much.

It is desirable that much and varied data on this point be obtained, not only to test this coefficient, but in order that the elements of a better formula may appear. This rule indicates that the *slope* of ordinary rivers is not appreciably affected by wind, while water 6 inches deep may be driven entirely out of a pond by a not very uncommon wind, if the bordering ground rises not faster than 8 inches to the mile; and that a stream 2 feet deep, falling 2½ inches per mile, will be stopped by a 40-mile wind, unless its feeder can furnish it more head.

Now suppose a canal 4 feet deep with a fall of 0.4 feet per mile, and a 40-mile head wind. How shall we calculate velocity? Will it be proper to simply reduce the 0.4 fall to 0.3, and use that as though no wind were blowing; or should we calculate velocity due to 0.4 then to 0.1, and take the difference; or may we suppose the wet perimeter to extend clear around, thus diminishing the hydraulic radius, and use some averge coefficient, if so, what slope must we take, 0.3, 0.4, or 0.5; or must the problem be approached from an entirely different standpoint?

The last paragraph above is inserted only to enumerate the plans that may suggest themselves before the proper one is determined upon.

The Chairman stated that this question would remain open for discussion, and that communications from any one in the Society were invited in order to examine into a subject that promises to be of considerable interest. He hoped that it would be brought up again in the near future, and advised the circulation of Mr. Hughes' statements among the members.

Adjourned. OTTO VON GELDERN, *Secretary.*

Notes and Comments.

The publishers of Industry are compelled to thank *en bloc* their friends in all parts of the country for the many kind and encouraging letters that have been received commending the change in form and other features of the Journal. It has been considered a strained proceeding to publish such letters, and, with a single exception, it has not been done; still, they are none the less welcome, especially when they contain suggestions.

Industry, like Prof. Sweet's engines, may not be the best technical journal, but it is the best the publishers know how to produce under the circumstances. The Journal consumes its revenue in creating itself. This, with other features of the enterprise, has been carried out in accordance with the scheme laid down in 1888. It could, perhaps, have been built up faster, cheaper and larger, by adventitious methods, but not as a "solid" property. It has cost a good deal of money, all of which belongs to the owners, who risked their capital and labor on the proposition that whatever is "true" and honest will in the end find support. The letters above referred to prove this proposition. To each and all, therefore, this acknowledgment is made.

Engineers and others in the East will, before long, learn something of the nature and efficiency of tangential water wheels. The Pelton Water Wheel Company tendered recently for a plant of 3,000 horse power, required by an Eastern manufacturing firm. The estimate, and all other conditions, were acceptable, but the Eastern firm, and their advisers, claimed that Pelton wheels were crude and of low efficiency. Thereupon Mr. A. P. Brayton, Jr., of the Pelton Company, and their engineer, Mr. Jones, formerly of this City, sent a 36-inch wheel to the celebrated testing plant at Holyoke, Mass., where a trial was made, during severe cold and other unfavorable circumstances. The "quantites" when checked up showed an efficiency of 87.7 per cent., just a little more than the maximum attained by pressure turbines at the Centennial test of 1876, that being, with twenty or more wheels tested, 87.68 per cent. The account of the Pelton wheel test comes to hand just at closing these columns. In the next issue a farther and more complete account of the matter, with attendant facts, will be given.

The leading article in our present number, by Mr. Otto von Geldern, C. E., Secretary of the Technical Society, is one that will be read with interest alike by professional and unprofessional people. The subject is one with which the writer is well acquainted, as his treatment of it will show, and he has exercised commendable and unusual skill in divesting his essay of technicalities so it will be understood by any reader. It is a subject pertinent to the time and circumstances, one just now absorbing much attention, and one that must, in the future, be considered a great deal more than in the past. On this Coast the problem of sea carriage is mainly one of harbors, and of these Mr. von Geldern will give full information.

The transfer of Lieutenant Finley, from the San Francisco Meteorological Station, is a matter to be deplored. Meteorology is a peculiar science, one in which the work of a preceding officer cannot be turned over to a new incumbent, no matter what his ability may be. It is a local and personal science, so to speak, and this station is perhaps the most important one in the country. At the interior or Eastern stations, there is land, or as we may say, a continent to windward or "stormward;" here, only water. This is a "terminal" station, and must depend on averages of originally observed phenomena. Lieutenant Finley had partially completed his work. He should be permitted to finish it. An effort is being made to secure his re-appointment for that purpose, which it is trusted may prove successful.

The next regular meeting of the Technical Society will be held at their hall, 819 Market Street, in this City, on the 4th of March, beginning at 8 P. M. The paper of the evening will be a lecture on "Mnemonics," by Dr. Reinhold Heidrich, of San Francisco, as applied to memorizing technical formulæ, and in other cases. The art, it may be called, of mnemonics, is one too little considered, and too little applied. Knowledge of all kinds consists in what is remembered, or what can be deduced from what is remembered, and whatever stimulates or promotes the faculty is of great importance. That the memory can be cultivated in a wonderful degree is proved in various ways, although there is no recognized system of such cultivation, a matter much to be wondered at in these times. Dr. Heidrich's lecture will be, no doubt, of much interest as well as use, and a full attendance is expected.

From a notice in the *Locomotive*, we learn that Mr. J. H. Cooper, of Philadelphia, a well-known writer on technical subjects, is engaged in translating and revising the "*Iconographic Encyclopædia*," a German work of a remarkable character; remarkable, because of containing some thousands of fine explanatory drawings that are "like the things represented." It was a very expensive work originally, also a very extensive one, that on the whole contained, perhaps, more accurate technical references than any other that could be named, in any language. Mr. Cooper's qualifications eminently fit him for the task he has in hand, and it is, we imagine, a congenial undertaking after his forty years or so in active engineering work of the constructive kind.

There have appeared, recently, some very severe criticisms of the work and procedure of the U. S. Army Engineer Corps, which, if read, as is commonly done, without knowledge of a considerable jealousy between the civil and goverment branches of the profession, will lead one to suppose that the work of the Corps is a series of blunders; in so far as the Atlantic Coast, at least. The criticisms have been acrimonious, and some replies, not of the dignified kind that could be desired. The attacks have been, in one case at least, directed against the personelle of the Corps, which is certainly not called for, when this bureau stands above a breath of suspicion as to honesty, and the routine of qualification precludes incapacity. The works, which the Corps of Engineers direct, are such as to involve failure in many cases, and a fair margin has not been exceeded. The vast forces of nature to be battled with are neither regular nor computable. On this Coast the Corps, under Colonel G. H. Mendell, have not only avoided controversey, but have, so far as known, the full approbation and coöperation of the civil branch of the profession.

The Risdon Iron Works Company, of this City, have recently published what is, perhaps, the best and most complete catalogue and treatise on ore milling and treating machinery, that has ever been issued in this country. Two years have been consumed in preparing the engravings and text of this division, which is one of several that will go to make up a general catalogue of the works. One other section, the hydraulic one, is also nearly completed. Down until three or four years ago, our engineering and machine works were but poorly represented in their printed matter, but since that time there has been a great change, and it is questionable if in any other city in this country can be found better circulars illustrating the various industries. The present one contains 135 pages, and over one hundred and fifty engravings, nearly all of which have been prepared for the present publication and in accordance with many changes and improvements in the machinery represented and described. We propose, with the company's consent, to reproduce in our next issue some of the technical matter of this catalogue.

The Union Iron Works and ship building company, of this City, have acquired the Pacific Iron Works, with its large and complete plant, one of the best in the City. This may be said to complete one of the greatest engineering concerns in this country.

This movement of the Union Iron Works has much to recommend it. The water front and large land area required in shipbuilding, forced the Company to move their works to the Potrero, and in this movement they were, to some extent, severed from their mining, millwrighting, steam engineering, and general engineering work. There is always a desire on the part of purchasers to "visit the works," and, in fact, the skilled and professional class of clients always do so. This is of mutual advantage, or, as may be said, is of especial advantage to the works, because among California clients, the managers of mines, and so on, a great share of their purchases are made upon suggestions derived from seeing things. This has been either very inconvenient or very expensive in the case of the Union Iron Works for some years past. The public means of conveyance to the Potrero have been such that a visitor before he reached there had attained a frame of mind that impaired his opinion of all that could be seen at the end of the journey. The result has been that the Union Iron Works Company had to provide private conveyance by land or water over the two miles to the Potrero, at considerable expense, and also a loss of time that had to be spared in business hours.

The new branch will be the most central of its class in the City, five minutes' walk from the Palace Hotel and principal centers of business. The Pacific Iron Works, as before mentioned, have a fine equipment of tools, patterns, drawings, handling machinery, and a connection of much value, all of which can be turned to a vigorous activity under the new management. A gun finishing plant would complete the combination.

Those who think Sir Edwin Arnold's title and fame rest upon his *Light of Asia*, and that his solid knowledge and powers are swallowed up in a dreamy idealism, will change such opinion when they read his recent article written at Kansas City, for the *North American Review*, on the "Duty and Destiny of England in India." As an historical event, or fact, British rule in India furnishes great lessons, useful to be learned at this day, and is, perhaps, less understood in this country than any other great fact of modern times. Sir Edwin Arnold will soon be a visitor here on this Coast, and a fitting introduction is this essay on a subject of which his knowledge is complete. His article, accompanied as it might have been, with a statistical appendix, would have given a better idea of British India and its circumstances than some extensive books on the subject.

We have received No. 1 of *The Tramway and Railway World*, a very finely printed and prepared serial, published in London, and devoted to railway and tramway interests generally, without distinction as to country. Without further remark concerning the makeup or particular nature of the journal, which will speak for itself, we venture the prediction that it will not be the last technical or trade serial to ignore geograpical lines. The present number seems to be neither English nor American, but both, and deals with the subject generally, irrespective of environment, as medical journals do.

John Bright once said he could see only one power that could successfully oppose war, and that was international trade. He should have added an international literature, which in spite of the jingo spirit, and as civilization goes on, is becoming more and more independent of political lines. Even now the community of interests between American, English, German and French research, writings, and intercourse is such, that it would be a considerable power in opposing the "destructive idea" among the people.

Mr. Hall, the elevator man, came into this office a few days ago, and asked the following question : "Why is not cylinder displacement under a given pressure, a proper coefficient, or measure, of efficiency for a hydraulic elevator? I propose," said he, "hereafter to make the sum of displacement in cubic feet per diem, multiplied into pressure, the measure of a machine's work, and to compare steam and coal consumption with this quantity." The idea is a correct one, or at least seems so. At present we have, load raised, the number of trips, and other quantities, to measure and compare the efficiency of elevators, but suppose instead of this we have 300 trips a day, using 20 cubic feet of water per trip, and load raised 95 feet. The quantities under Mr. Hall's proposition would be: 6,000 cubic feet of displacement under 40 pounds of pressure for a day's work. Against this could be set the power, or coal consumed, and any other case compared by the same rule. This, like the million foot pounds of duty for 100 pounds of coal, employed in stating the efficiency of pumping engines, could become a rule for elevators, which now seem to lack any ready means of being estimated as to their efficiency. Perhaps the million foot pounds rule would do.

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The advent of type-writing machines is an important adjunct to the business and literary affairs of our time. It has come so suddenly and quietly that its installment has been scarcely realized, and now it is to be included in the curriculum of our colleges and schools. Messrs. Leo. Alexander & Co., of this City, the agents of the Smith Premier type-writing machines, inform us that they have furnished to the Board of Education, in this City, thirty-two machines to be employed in the public schools. The same firm have supplied various colleges and educational institutions here, so that we may conclude that type writing and hand writing are hereafter to go together. These Premier machines, of which we have some knowledge, are what mechanical people would call a "wonderful bit of scheming," and the mechanism could well be made the subject of technical inquiry. The origin, rise and history of the art will no doubt soon appear in a book, and it could be made one of much interest.

It would be a wholesome proceeding if cities where gas is supplied by private companies, would investigate its cost, quality, and the various conditions of its manufacture. There are very few private gas works that are not extended out of earnings, and the stock watered up to the maximum value of the plant. At Cleveland, Ohio, for example, where one would expect close scrutiny in such matters, it is claimed that $100,000 has been watered up to $2,500,000, or twenty-five times, and still dividends of 150 per cent. paid each year. This, which we note from a contemporary, seems improbable, especially for Cleveland, but it is quite time that anything so necessary as gas should be supplied at prices that bear some definite relation to the cost of production. At Cleveland, the city will no doubt acquire the old gas works, or construct a new plant. The people there are progressive in such matters.

We traveled four years ago, from Austin, Texas, to El Paso, with the President of the "Wool Growers' Association," who was then making a circuitious route to Washington, where he was going to urge an increase of the import duty on wool to keep up the price. We ventured the prediction that an increase of duty would not raise, but would lower the price of wool, and had the distinction of being set down as a lunatic; but the very thing predicted has come about, and the price of wool has fallen about three cents a pound since the increase of duty. The present rate will stay, no doubt, until both wool and its manufactures are "let alone," and take their normal place in our industries. Woolen cloth is a peculiar commodity. It is bought and consumed up to the buyer's or wearer's resources. We all buy as much, and of as good a quality as we can afford, but the law of consumption is one too often overlooked in this and other cases.

The Chili hubbub, which the country has just passed through, if it be not a political scheme, as many seem to think, is simply disgraceful to both countries, and will leave an acrimonious relation that for many years will curtail, if not destroy, amity and trade. Chili has some excuse for hot-headed and mistaken diplomacy, having first passed through an internecine war that involved her whole population. We have no such excuse, but still seem to have done a good share of the muddling, beginning with the Trescott-Walker Blaine Commission sent there during the Peruvian war and recalled by President Arthur. A result of this was a kind of rebuff to the special commission that in 1885 visited Chili to promote trade with the United States. Our country is so large, and its circumstances so different, that the imbroglio may soon be forgotten here, but not so, we fear, with our Latin neighbors. On this Coast we have special reason to deplore such a situation in any of the South American countries of the Western Coast, and may well find fault with a diplomacy that has permitted, if not promoted, the quarrel.

It is a pleasure, and a pride, to see in the *Engineering and Mining Journal* an encouraging article on the ethics of engineer's commissions, and an assumption that the influences of associations and technical journals have, in some degree, mended the modern practices of pocketing dishonest commissions, which are frequently taken from both sides. It is a mild form of theft, the prevalence of which not only degrades the standing of professional skill, but detracts from its price and value many times what is gained by secret commissions. In building, for example, the commissions paid to architects is about one half what their services should be worth, and there is not a sensible man in a dozen who would not rather pay five per cent for good, honest service than two and a half per cent for second class service. It is the difference between good and bad quality, as in everything else. An architect, engineer, or other professional man, who accepts bribes against his clients has no place among honorable men.

The *Iron Age* names the countries that are to "suffer" under the retaliatory excise power conferred on the President at the last session of Congress; also the kind and amount of merchandise they send here. The countries are, Austria, Venezuela, Colombia, Hayti, Nicaragua, Honduras and the Phillipine Islands. The imports from these countries are coffee, sugar, goat skins and hides, and just how these countries are to "suffer" by an American impost on these things we fail to see. We produce no coffee, only a small share of the sugar consumed, no goat skins to speak of, and require the hides over and above our own product. The "suffering" will be for the American consumer. He is to be fined because these foreign countries will not adopt reciprocity. The difference is, we will pay more for these things, while the producers will, most likely, get just the same price they always have; but then we might do without them. The idea of "retaliating," or taxing a foreign country, which the phrase seems to mean, is an economic problem hard to understand.

The *Marine Review*, Cleveland, Ohio, calls attention to the harm resulting from the introduction of bills in Congress for canal appropriations that have no object, except to please constituents. These are not our contemporary's words, but its meaning is, that schemes of real merit, appealing to wide areas, or to the whole country, are smothered and rendered futile by these "private" bills that are local and impossible. This is one of the evils of representative government. Every member represents some section, including himself, but the nation has no representatives, and concessions of any kind are apt to be degraded into bargaining between districts, states, or divisions of the country. Where and how to find some extraneous power to parcel out appropriations, with respect to the whole country and the common good, is a problem coming nearer all the time. The *Review* names three canal bills, already presented, that can have no hope of success, and will merely hinder schemes of national importance, such as completing the great chain through the lakes, and connecting them with the Atlantic seaboard. A canal that does not reach tide water cannot be much of a canal anyway.

The New York *Nation* says the new Secretary of War, Mr. S. B. Elkins, is a "business" man; that among other business ventures of his was the successful manipulation of mines in New Mexico, which were affected by Congressional grants. He was also an interested and successful promotor of what was called the "Maxwell land grant," which was sold for some millions to a Dutch company, and ended in suits for fraud. He was also concerned with Mr. S. W. Dorsey, in the "star routes," in 1881, and later on was attorney for a private claim against Brazil for fifty millions or so, presented and passed by Mr. Jewett, Mr. Elkins being counsel. When Mr. Bayard became Secretary of State, he pronounced the claim shocking to the moral sense, and one that could not be considered in the domain of reason or justice. Mr. Elkins is, or was, a member of the North American Commercial Company that got athwart the Behring Sea arrangement of last year. If he is a "business" man, such as these statements will indicate, he is hardly suitable as Chief of the War Department.

A special committee, appointed by the Chamber of Commerce, in St. Paul, Minn., has just made a report on the subject of river improvement, which contains, among much other relevant matter, the following words: "It seems to be the fact, that, notwithstanding the work done by the United States Engineers' Department during fifteen years past, to improve the navigation of the Upper Mississippi, there was as much obstruction during the season just closed as ever before." A resolution was passed by the board requesting members of congress to secure legislation, authorizing the construction of works according to the plans of Captain Edwin Bell, of St. Paul.

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We note in a contemporary, mention of a large planing machine made by William Asquith, of Halifax, England, the table or platen of which, is in two parts, so that, either one, or both, can be used as the width or weight of the work may demand. The idea is not new with Mr. Asquith, his own largest machine, made certainly ten years ago, is arranged in this manner, and the plan has a good deal to recommend it. Mr. Asquith is a very original man in his schemes. His works are on a high hill, near Halifax, and are out in the fields, and as one would imagine, a block of farm buildings, Once inside, the visitor will find there a good many queer things. Among others a complete set of "one edge" reamers, very cheap, very simple, and as good as can be. There will also be seen caliper gauges, manufactured by Mr. Asquith a dozen years ago, before people were ready for them. The works are well worth a visit because of their novel surroundings and fittings.

Messrs. William Jessop & Sons of Sheffield, England, the celebrated makers of cast steel, print the following in their circulars, respecting hardening and tempering tools:

"No general, fixed rules will apply. It cannot be taught from a book. Only experienced persons should make the attempt, and the process depends upon the character of the work. Hardening is caused by suddenly extracting the heat, and the quicker this is done the harder the steel. The two great evils to be avoided are burning in the fire and "clinking" in the water, both of which are caused by overheating the steel. At the utmost, only a low red heat is required, and the lower the heat that effects the object, the better for the steel. The heating may be done in a coal or charcoal fire, or in a furnace, or in hot lead, according to the character of the work. Large steel articles are liable to crack if taken out of the water before they are thoroughly cold. Plain water with the chill off, say at 60 degrees Fahrenheit, will generally give sufficient hardness; but brinish liquids and chemical mixtures, the ingredients of which are kept secret, are often used. Oil sometimes best suits the purpose, and cotton seed oil specially prepared is very useful. After hardening, steel is very brittle and unfit for use until tempered; this is done by carefully reheating slightly, until the right temper is obtained.

Mr. Benjamin Brazelle, of St. Louis, proposes a system of governing steam engines, that is amusing in its simplicity, but serious in its possible effect. He employs both a throttling and a cut-off governor, on the same engine, so the initial pressure will rise and fall with the range of cutting off. To carry out the invention there is nothing whatever to do, but to apply a throttling governor, of the common kind, to any cut-off engine. The result is amenable to computation, and we leave that to our readers as a most interesting problem, the main point being why, in all search and research into steam phenomena no one has proposed to modify initial pressure in this manner, at least have not done so intentionally. A friend, to whom we were speaking of this circumstance mentioned a case where a cut-off engine "up in the country" was so "rigged" under a misapprehension, and went on in a very satisfactory manner. The *Iron Trade Review* of January 28th, publishes diagrams from a dual governed engine as proposed by Mr. Brazelle.

The whaleback steamers have been a topic before the American Society of Civil Engineers, and have been handled rather severely. Mr. Charles H. Haswell, an eminent authority in such matters, closed his remarks as follows:

"In conclusion, a review of all the elements submitted and claims advanced, does not present or substantiate in any one instance an advantage over that of an ordinary well constructed freighting steamer of like displacement and power, and alike without spars or rig; subject to the question if such absence of spars is at all practicable with the requirements of safety of the vessel and crew."

Professor Thurston spoke more favorably of these new vessels, but not in a commendatory view. Captain McDougall is not likely to gain much comfort from naval architects and engineers, whatever encouragement merchants and owners may extend, but it is these last he is most concerned with.

In some recent and carefully constructed experiments with a Parson "steam turbine," there was shown a considerable gain over previous results, but as the "quantities" are given in electrical units, comparison with a common steam engine is difficult. The common acceptance of this method of steam propulsion is, that about 40 pounds of water per horse power per hour is required. This is what is consumed on the *City of New York*, where the electric generating apparatus is driven by steam turbines, and Mr. Parson has not hitherto claimed better results, or at least, not much better, but even this, considering many other adavantages in certain cases, gives the steam turbine a place among modern motive engines. There is, however, one thing against them—the extremely accurate fitting they require is such as to preclude a general manufacture of them. An account of the Parsons engine and a drawing of it was published in No. 2 of this Journal.

There is no doubt that the Baldwin Locomotive Works have added a good deal, and surpassed in many respects, their European competitors in compound locomotive practice. The Vauclain type, of which engines have been made weighing nearly 200,000 pounds, is a distinct departure in many respects from standard engines, or even from precedent. The initial and low pressure cylinders are parallel, both connected to one cross-head, with a piston valve between, which performs distribution for both cylinders. This makes each side of the locomotive complete and independent, which of itself is quite an important matter, and the control of expansion by having two low pressure cylinders, is more complete. A similar valve arrangement has been applied to vertical tandem cylinders for marine purposes, and will, no doubt, answer completely for that purpose.

It is perhaps safe to suggest to those who are engaged in steam engineering, that some time expended on the subject of "down draft" may not be thrown away. There are a good many signs of change in this direction, and among these signs the attention given to smoke avoidance. It is about time, at any rate, that the one third or more of the heat units in coal lost by present methods of combustion, was taken up vigorously and prosecuted to some better result. Down draught, that is feeding the fresh fuel on the under, or intake side of the fire, so the new gases must pass through the incandescent fuel beneath, or on the grates, is a simple straightforward proposition, and the problem to be worked out is, what is the best manner of doing this? By far the most simple way is to reverse the draught, instead of turning the fire "upside down," and it is to this method that the term down draught is applied. In some recent experiments at St. Louis, Mo., with fifty square feet of grate surface, burning 31 pounds per hour on each square foot of grates, the evaporation was 10.85 pounds of water per pound of combustible matter. These experiments were made with the Hawley system of down draught, under Heine boilers.

The great flume-way at San Diego, in which work several of our San Francisco engineers were engaged, has never been described and understood in this State as it might have been. The total length of the work is fifty-seven miles, the catchment area being in the Cuyamuca mountains, 5,000 feet above the sea, where there is an annual rainfall of 50 inches. There is an area of 150 square miles draining into the first basin, which is an artificial one, formed by a dam 720 feet long and 35 feet high. From this basin the water flows twelve miles in an open channel to a second dam, 400 feet long and 35 feet high. Here begins the great flume, 6 × 4 feet, 36 miles long, made of redwood plank two inches thick. This flume, with a fall of 4.75 feet per mile, conveys 65,000,000 gallons a day, enough to irrigate 100,000 acres of land. There are on the line more than 300 trestles, one of which is 1,664 feet long and 70 feet high. Another is 1,264 feet long and 80 feet high. There is one tunnel 1,900 feet long, and one 700 feet long. This great work was done in two years' time, in the face of great physical impediments, and was, in a sense, the salvation of San Diego. It is also significant in the fact, that it illustrates the heavy precipitation along the first range of Coast mountains, which can be made available at almost any point for watering the Coast.

There was mentioned in these columns some time ago, an improvement in gas engines that makers here may do well to keep in view. It consists in enclosing the crank and connection in a tight case, and drawing the gas and air into this case by the inward or upward stroke of the piston. On the back stroke this charge is partially compressed and passes from the bottom to the top of the piston by uncovering a port for that purpose. The piston on the inward stroke again compresses the charge, which is then fired in the usual manner, giving an impulse at each revolution, and doubling the usual power of these engines. There is but one point in the whole that seems questionable, and that is the expulsion of the burnt gases, which it is claimed is performed by the method of introducing the new charge. This flows over a kind of vane formed on the top of the piston, and out at a corresponding port on the opposite side of the cylinder from the induction one. The engines have no valves whatever, and if the expulsion operation is reliable, will much cheapen this class of motors. The engines are made at Bristol in England, seem well designed, and are of course extremely simple.

The consolidation of the Thomson-Houston and Edison Electric Companies, now expected, will, among combinations of the kind, be the most important that has happened, because, more than any other, indicating the trend of such interests to centralization. Both companies, and the industries they carry on, are new. They are not interfered with by foreign competition, and, it is presumed, are following the natural bent of organized labor in this country. The ultimate effect of such organization, whether good or bad, and what its real nature, is a mystery at this time. The social effect, which will be the principal one, cannot appear for a long time to come. The economic and political effect are only symptoms. In respect to present facts, it seems that extensive and permanent industrial combinations are much less to be dreaded than the small ones controlling districts only.

The Green patent on the electrical propulsion of railway cars, respecting which so much is now being said, and which is a romance in patent procedure, means, if anything, a new tax on the consumer. Green filed his application for a patent on electrical propelling apparatus in 1879, and had, unquestionably, invented something that is of value now, but presented his case so clumsily, and its import not being known, it was knocked about through various amendments and appeals until finally issued December 15th, 1891, under a decision by the United States Circuit Court. To our mind the whole matter, whether by the Field family, Green, or others, is an attempt to blackmail present industry by the technicalities of law. At least, it would be hard to show how either of these contestants have contributed anything of value to electrical science, even through the vague field of suggestion, and the sympathy with such "sprung patents" is mainly through a desire to see the "other fellow cinched," but the "other fellow," in the end, means the public. Siemans and Edison, other contestants for priority, stand in a different position.

The Edison Company are building in New York an electrical power station of 30,000 horse power, divided among six engines of 5,000 horse power each. These engines will be of the inverted steeple or marine type, quadruple expansion, and are expected to develop a horse power with one pound of coal per hour. Whether this be possible or not remains to be seen, but one thing is certain, the type of engines, boilers of high evaporative power, such as are not possible at sea ; a constant resistance ; the stroke and piston speed arranged at choice, the Edison Company should gain a great deal over marine engines, which are now propelled with less than one and a half pounds of coal per horse power. Thus far, however, the people at sea are ahead, notwithstanding a good many disadvantages of one kind or another, and some advantages too, such as plenty of cold salt water for condensation, and the avoidance of regulating apparatus.

California has been late in adopting electric propulsion for city railways, but now seems to be making up for lost time, and, in the end, will be a gainer by delay, on the principle of letting others do the experimenting. Among the mass of advertising matter that has been written respecting electric traction, there is now beginning to appear disinterested and reliable statistics respecting first cost, operating and maintaining electric railways, and the facts are in their favor. The city of Glasgow, which was "canny" enough to provide for owning its city railways at the end of a charter term, will acquire them pretty soon, and, as one of our foreign exchanges says, has decided to employ the electrical storage system for propelling all the lines. Most of them are without serious grades, and the method will have many claims there over the trolley system.

The part that electricity is to play in warfare is just now, for the first time, a subject of discussion, or conjecture rather. That it may form a means of defense against personal attack is possible, and probable, but it is almost equally probable that the time of personal attack by armies is past. Mr. Edison may devise means, as he suggests, of preventing an army from approaching a fort, bnt this is already done. Armies can no more approach a modern fort than they can a volcano, but if he can manage to put a warship in circuit with a current strong enough to "hypnotise" all on board, it will be a vast improvement on the sneaking torpedo of our day. It would put the navy departments to the expense of insulation, as well as providing torpedo nets, and as the main idea of our time seems to be exhausting the enemy's exchequer, the apparatus and insulating would consume a good deal of the earnings of human industry in all countries. Our opinions of war, and all of its belongings, are of the Quaker type, and include the view that to drag electric science into this ignoble field will be a questionable advance in what most people consider civilization.

The Diamond Prospecting Company, which does not seem a relevant name for the business, are making at Chicago an electrically driven drilling machine, operating with diamond point core drills. The movement being rotary, an electric motor is well adapted to the purpose and fits neatly into the supporting framing, and the whole seems an improvement on the steam-driven machines commonly known. It may be noticed that in all industries requiring portable machines, or power, that electrical transmission is soon adopted. The requirements in mining operations are such as to call for portable apparatus of various kinds, hence an extensive application of motors for underground and all prospecting operations.

The question of aggregated or segregated power for electric stations is no nearer settled than it was five years ago. The tendencies have changed several times in that period, but just now seem to be toward segregation, or separate engines for each large generator. There are three types of engines in the case; large engines of moderate speed; high speed, double acting; and high speed, single acting engines. The problem is divided into two branches, one relating to mechanics, the other to economy, and a third one, which really governs the other two, is adaptation. This latter may determine half the cases, but in the other half there is the open question of one or several engines for a given work. Precedent and analogy favor large engines, and has perhaps been the most potent cause for adopting that system, in many cases at a loss in working expenses.

There are on the River Thames, at London, about 30 launches driven by electrical storage batteries, one 65 feet long, with 10 feet beam; another now building 75 feet long, 13 feet beam. There are also a number of orders for such launches, and, it is safe to say, there will be fifty or more in the Thames before the end of the year. There is also, going on just now, an enterprise for keeping electric launches for hire, by the hour, day, or distance. The company are putting down a charging plant, with an engine of 100 horse power, to supply their own and other boats. One hotel, on the river at Richmond, has ordered two launches for the use of their guests, and therein lies an idea for our own hotels situated on the water, especially on rivers or lakes. Such hotels have, usually, an electric plant for lighting, and could, after midnight, charge the batteries of boats at a moderate expense. It is strange so little has been done here in the way of electric propulsion for boats.

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JOHN RICHARDS, Editor.

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PROFIT SHARING.

The first organized movement to promote "profit sharing," as it is called, has been instituted by the appointment of Hon. Carroll D. Wright, U. S. Labor Commissioner, as president; Francis A. Walker, president of the Massachusetts Institute of Technology, and Mr. N. O. Nelson, of St. Louis, as vice-presidents of an Association to promote the scheme. This certainly seems like giving the matter serious attention, when men of such eminence are concerned, but as we have many times pointed out in these pages, such a system has no promise of permanence. It makes a workman a dependent. He should have nothing to do with profits, except on his own work, and these he will look out for, if his work is set off as an independent element in production, as it can be in nearly all cases.

It is very common, if not the rule now, in New England shops to contract the work to a "few people," and there is nothing to do in order to arrive at a complete system, but to contract the work with "all of the workmen."

If there has to be leaders, foremen or others in authority, in the management of work, let the men themselves provide this, as they will do and have done in many cases, notably in the skilled iron industries in England.

To the profit sharing scheme there are many and formidable objections. First and mainly is the ethical phase of destroying independence and creating dependence. It is a move in the backward direction, by which workmen are made to depend upon the integrity of an employer's accounts. It also serves to establish a community of interest between elements that will not assimilate, and to create a relation that is in a sense more servile than time labor. The platitudes we hear of a common interest—"the employer and employed bound together," and so on—are not in the spirit of our time, and applicable only to very exceptional cases.

Mr. Nelson, at St. Louis, and Mr. Grubb, at Bessbrook, in Ireland, may manage in this manner, and doubtless many more can, but this does not prove that such a rule will apply generally, and the chances are that not one employer in ten can successfully carry out such a system.

Another objection to profit sharing is, that workmen will not care to invest their labor, so to speak, upon the judgment of employers. Their labor, which is their capital, is not flexible like the funds of the employer. It must bring constant and definite returns to provide the necessities of life, and should do so, because the service rendered is also definite and a fixed quantity. An employer may engage in a business that is not called for, or found one on a supposed improvement or invention that his workmen are in no way responsible for, and he has no equitable right to ask his men to share his risk. That is purely his own business, and should be so regarded in every arrangement or contract with workmen and every one else. This is the common sentiment, not only among workmen, but among communities as well, one that is controverted by the profit-sharing proposition.

Besides this, there is the uncertainty of profits, which from a statistical basis will show how impracticable any general rule will be. It may be said that business ventures involving skilled labor are commonly successful, but if they are successful, the success is not regular or progressive from the beginning. The general average over a number of years may be a success, and this may satisfy the circumstances of capital, but not of labor, which, as we have just pointed out, cannot afford to take chances.

The two elements of labor and capital are in this respect essentially different, especially in this country where the fiscal system pursued, and the want of a foreign trade in skilled products, produces continual fluctuations of prices, with "good times" and "bad times," as we say.

In the present aspect of the labor problem, it is natural that those who employ skilled workmen should look with alarm upon any scheme that will permit labor to operate independently, believing as they do that labor is not competent for its own control. There is much to warrant such a conclusion, because of an unnecessary hostility between labor and capital, which causes workmen whenever opportunity occurs, to attempt reprisal and proceed to exactions which would destroy our industries. Employers therefore naturally turn to what seems a method of retaining control, in "dividing profits." It is an employers' scheme purely, and will be so regarded when analyzed and understood; one that in the end will no doubt lead only to greater complication.

It is in part, perhaps mainly, suggested by a desire to conceal the relations between capital and labor, as elements in production, not that capital is receiving more than its share, but because for political reasons it is desirable to convince workmen that they are receiving higher wages in this than are paid in other countries.

Any method of paying labor in proportion to its productive power, would soon disclose the relation of wages in this and other countries, for all staple manufactures, and while this might not raise wages, it would lead to an investigation of the cost of other components, such as material and expense, and this would at once controvert the assumption of a possible trade with dear material.

The only solution of the labor problem that meets the spirit of our times, is one that will make labor responsible for its earnings by setting it off as an independent element in production. Independent of the risk of investment accounts and profits. In other words, make it free and responsible, so workmen will rise to a higher manhood and above the contemptible schemes of the boycott and strikes, which emenate from his position of dependence and an opinion that the employer is responsible for their living.

Those who do not understand it will say, how is labor to be set off and made responsible as one of the elements of production? The answer is very simple. It is, in fact, already done in so far as data or "quantities." In every manufactory producing staple or uniform products, there are kept accurate accounts of the labor cost of commodities produced. Each yard of cloth, each plow, locomotive, wagon, clock, watch, and even each paper of pins, have against them a labor account. So has every house built, every suit of clothes made, every article manufactured, and there is nothing to do but to turn these estimates over to the workmen, and make them responsible for this part, which is the one, and in a sense the only one, they deal with.

We have in former remarks on this subject pointed out its practical working in the "machine trades" of England, but it will be necessary in this connection to again briefly describe the system.

If a machine, or other work that can be called a "job," is to be made, the first thing to be done is to make up an estimate, just as is done here and every where else. This estimate contains four elements, namely :— material, labor, expense, and profit. In the system we are describing, the employer assumes three of these elements— material, expense, and profit, and turns the other one, the labor, over to the men who are to perform it.

The job goes into the shop or factory under a catalogue number, with a definite estimate of the labor, which is accepted by the men upon rules long established, or by an agreement, if the work be exceptional. The men's time tickets show charged to this job, or its catalogue number, every hour of labor spent upon it, by all hands, in whatever position they may be, including apprentices.

The men draw stated wages each week, adjusted as nearly as possible to their relative skill, and when the work is completed the account is made up. All the time charged against the work is made up at the men's weekly rate, and the sum of this is subtracted from the original estimate for labor. The balance or surplus is divided pro rata among all who worked on the job, in proportion to their time and their weekly rate of wages.

In this manner the men become responsible for the labor cost of the work, and also for its quality, because any losses due to a want of skill, or accidents from carelessness, are charged to the "estimate," and the men have to make the amount good in the final settlement.

We need hardly point out the difference and advantages of such a system, compared to "profit sharing." One is common sense, fairness, and a recognition of manhood and responsibility on the part of the workmen ; the other a kind of fraternal or paternal idea, predicated on qualities that workmen do not possess, applicable perhaps in some of the Continental Countries of Europe, where it had its origin, and where feudalic ideas remain among the people, but is in no way suited for this country, and is not in keeping with modern tendencies.

One objection to a free contract system before mentioned, lies in the dread that manufacturers and employers have of disclosing the labor cost of commodities. Some reason for this has already been given. A few years ago the Massachusetts Commission of Labor went to the pains of ascertaining the relative amount of labor and other components entering into the various manufactures of that state, and in so doing must have arrived, in many cases, at the money cost for labor on various staple commodities made there, but if so, were very careful not to give such facts to the public. A letter to the Commissioner of Labor, in that state, elicited a remark that the relative labor cost of commodities involved the expense of living and the purchasing power of wages, which we need hardly say has nothing whatever to do with the matter, from the workmen's side. Wages paid in gold or silver have practically a uniform value the world over, so have various staple products, like cotton cloth, boots and shoes, various kinds of hardware, and even locomotives, and even if the value of the product was more or less, expressed in our prices, comparison could still be made respecting labor cost.

We are speaking of this matter to show that there is a serious objection to declaring the labor cost of commodities in this country, and also to point out that a free contract system with workmen does not call for disclosing such cost, any more than in the case of other private accounts. It is not done where this contract system is in use, a fact that we have proved by failure in a number of cases to secure data respecting the amounts and methods of division in British shops. In conversation with the owner of a works there, some years ago, it was remarked that the men seemed to manage the shop under this contract system, or "estimate" system, which is a better name. "I am quite willing they should," said the owner, "I have enough to do without that."

The ethics of a system that places the responsibility for the labor component on workmen can be perceived by inference, if the conditions are followed out. A man may do a day's work if he is paid a rate per diem for service, or he may not. The incentives to do so are his self-respect, and fear of losing his situation, and the employer must provide some means of enforcing diligence and industry. This is done usually by the espionage of a foreman, who has the power to discharge men, and is set as a kind of spy over them to see that a day's work is done. This, indeed, is his principal function in many cases. In an estimate shop the men themselves will see that a day's work is done, because anything less affects the earnings of all, and as a remarkable matter, this method of working prevents "scamping," creates a kind of *espirit de corps* among skilled workmen unknown with those who work by time. Their minds are concentrated on their part — the labor — and they are not worrying and inquiring respecting the employer's business, as they naturally would be in any case of profit sharing, and where their earnings were contingent upon the conduct of the business.

We have no faith in "profit sharing" as a method of employing and managing skilled labor, and make the prediction that it can not succeed in any but exceptional cases in this country.

GERMAN SOCIAL DISTURBANCE.

A non-philosophical explanation of the social disturbances in in Berlin last month will be to say the German people have too much army, too much Kaiser, too many taxes that fall on the consumer, and too little bread. The policy of Prince Bismark in levying impost taxes that increased the cost of all kinds of manufacturing material, and smothered a German trade that was rapidly expanding, was with him a desperate means of providing revenue. No one can suppose that with his knowledge of the laws of trade, and the examples of other countries before him, that his financial policy was one of deliberate judgment, and intended for the betterment of German industry. It was a scheme then available for maintaining militarism in the empire.

The present discontent, or rather the manifestations of it on the 25th and 26th of last month is due to deeper causes than a declaration of authority by the Emperor. We imagine that a great share of the German people do not care what the Emperor declares, so long as it does not lead to bad laws and oppression. The day of the Hohenzollern is past; even the genius of the Fredericks would not avail in these days. In Carlyle's words: "The true epic of our time is not arms and the man, but tools and the man. An infinitely wider kind of an epic." Ours is an age of tools, not of swords, which are the accompaniment of kingly sway.

The German people have had a serious time in hammering out some kind of free government and a fair degree of personal right, and at the same time thinking and learning a great deal that unfits them as subjects of a centralized government. They do not need such a government, and will not have it when its policy leads to industrial and commercial failure as the present one seems to be doing. The inspiring *Wacht am Rhein*, and *Was ist des Deutschen Vaterland?* will not appease hunger, although it may cause people to forget it for a brief time.

The transition of the German people from a feudalic monarchy to a system of government by intelligence, has been going on very regularly for a long time; a fact well understood by the last Frederick, who had, without doubt, made up his mind to various reforms. Such a cause was not only prompted by an observance of the tendencies of the time, but by his own inclination.

A monarch who holds his title by descent alone is an anomala at this day. The possibility of this is in the assumption that the heirs to thrones will inherit the qualities required by a ruler, and no ruler in Northern Europe is likely to remain long a king by descent alone. The next few years in Germany is to prove the truth of such a proposition.

WATER PIPE BUILT OF WOODEN STAVES.*

BY D. C. HENNY, C. E., MEM. TECH. SOC.

Wooden stave pipe has been so largely used in some of our western states, notably Colorado, for carrying water for domestic supply and irrigation, that it is surprising to find this kind of pipe comparatively little known in California.

The title of this paper indicates my intention not to discuss wooden pipe in general, and if I refer to bored log pipe here, it is because experience with it extends over a longer period, although the use of wooden stave pipe is by no means new. That a century and less ago hundreds of miles of bored pipes have been used in England and in some of our eastern cities, before there was a demand for high domestic pressures, is well known. But what is perhaps not so generally understood, is that their abandonment has not been due to any supposed or real unfitness of clear sound wood as a water carrier, but to mechanical causes, involving both its strength and its cost. And it is for this reason that their use has been resumed, in such shape and with such improved methods of manufacture, as to make it meet the requirements of the present time.

The remarkable lasting qualities of wood, when constantly under water are well understood. A wooden pipe filled with water, under pressure is, as far as the wood is concerned, in the same condition as if it were submerged, even though the soil in which it lies be

*A paper read before the Technical Society of the Pacific Coast, February 5th, 1892. Republished by permission.

perfectly dry; provided of course that the thickness of the wood is not excessive, so that the water can penetrate it for its full thickness and thus maintain a condition of complete saturation. The experience with bored log pipe demonstrates this fact. Numerous are the instances of bored logs, dug up after many years of service, and all such pipes were sound when taken up, unless they had been suffered to remain in the ground long after they had been abandoned.

The principal qualities which material for pipe should possess are water-tightness, smoothness of interior surface, and durability; great strength is not necessarily one of them, for although the strength to resist inside pressure may be vested in the material of the shell itself, as in uncoated iron and steel pipe, it may also be concentrated upon the outside surface, or spread around it, and thus be kept from contact with the water. In fact, when we consider the great care exercised in coating iron and steel pipe it is apparent that the coating forms the real shell, the material back of it simply serving to support it. This is especially evident in the cement lined pipe, which has been much used in the East, the cement having no strength of its own against bursting. The necessity of coating iron and steel pipe is, of course, due to their being short lived materials when in contact with the water, and for this reason undesirable for pipe shell in the sense the word is here used, although eminently fit to support it. Use wooden staves instead of asphalt varnish for a shell, concentrate your metal in the most advantageous form around it, and you have the wooden pipe of which I am to speak. I do not mean to imply, however, that in this manner the stave pipe was evolved in practice, for it has too close an analogy with the ordinary water tank and barrel to doubt that these were its real progenitors.

DESCRIPTION OF PIPE.

This pipe may be considered an indefinitely extended horizontal cylindrical tank. The staves are dressed like tank staves, the flat sides to the cylindrical surfaces conforming to the inside and outside diameter of the pipe, the edges to radial lines. Some pipes have been built with slightly V shaped edges, male on one side, and female on the other, which offers some advantages in its construction, but does not give as firm a bearing of one stave upon the other. Thus far the pipe and the water tank are exactly alike. The difference enters with the necessity, with pipe, of joining the butt ends of the staves. Joints are generally weak places in all pipe, and it is an advantage with this pipe, that the staves can be made to break joint so that this weakness may not occur at the same point, but be distributed along its length; in this manner the pipe becomes one continuous stiff tube, with no tendency to settle in one place more than in another. To find a sure and simple method to make the butt connections tight under pressure, Mr. C. P. Allen, some nine years ago, while chief engineer of the Denver Water Company, being called upon to construct a 48-inch pipe line for his company, instituted a series of experiments, the results of which he finally patented. It is under this patent that most of this pipe has been built.

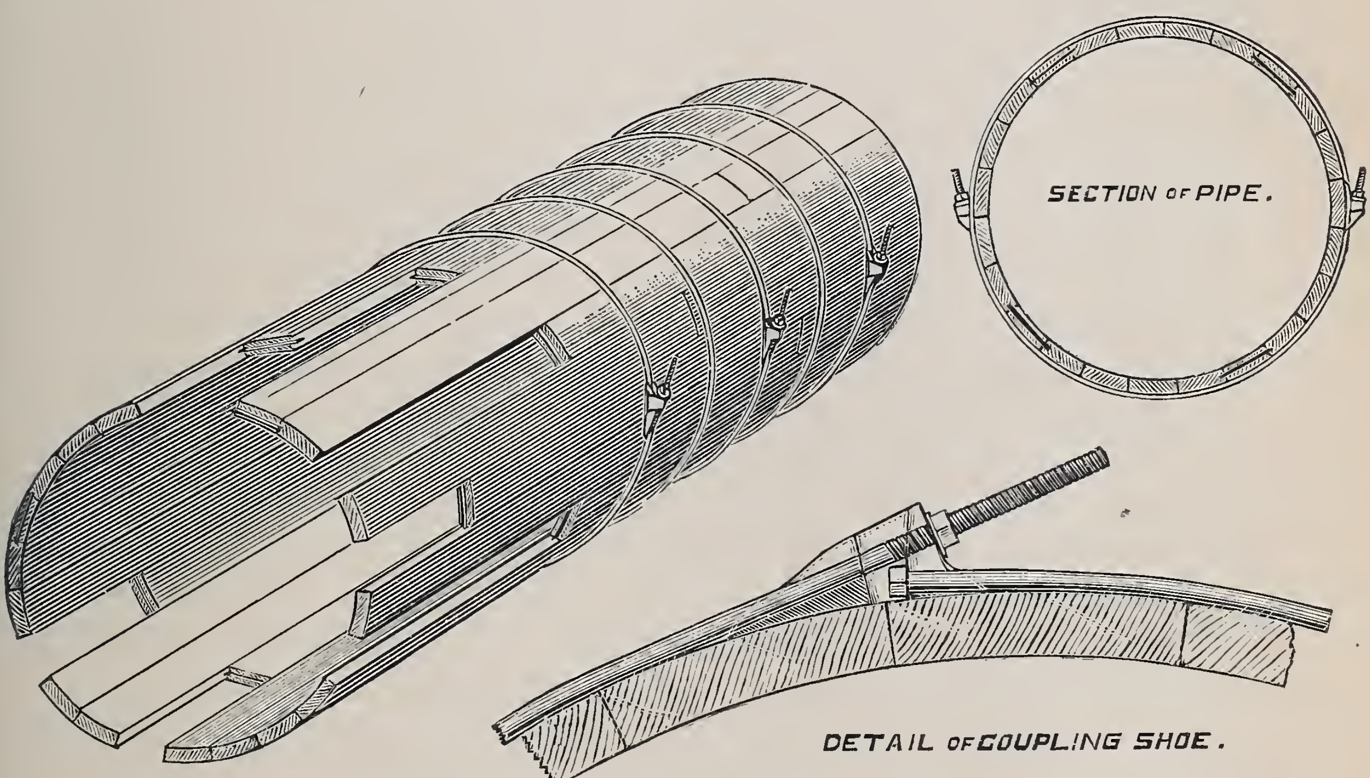


Fig. 1.

His experiments covered both the best butt joint and the most practical form of bands and shoes. The ordinary tongue and groove was tried, and so were other simple wood connections. Whether it was due to the difficulty of cutting and preserving the sharpness of all corners and edges; whether to slight imperfections of the wood at the ends of the staves, such as small shakes and cracks; to a greater deflection under pressure of the stave at the joint, than of the adjoining stave where no joint occurs, or to other causes; the pipe showed an aptness to leak at the intersection of the seam and butt joints, in other words, at the corners of the staves. It was not until the simple device of inserting a piece of band iron in the end of the stave was resorted to, that the problem was satisfactorily solved. As it is now used, the plate is usually cut of No. 12 band iron, one and one half inches in width. The stave is slotted in the ends to receive these plates, as shown in Fig. 2.

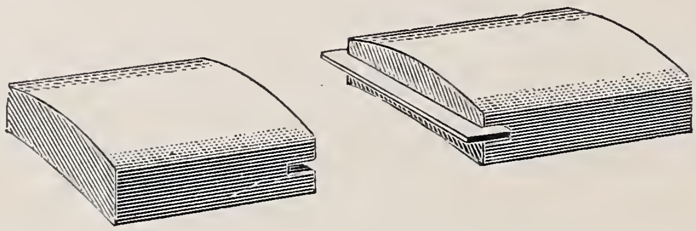


FIG. 2. VIEW OF BUTT JOINT.

Now imagine a joint without the plate; the space left for it is smaller in all directions than the plate itself. It is less wide than the thickness of the plate, so it fits snug, and the edges of the plate penetrate the wood, sidewise in the bottom of the slot, and endwise in the side of the adjoining staves. It carries the contact of stave against stave, as far as water tightness is concerned, back ¾ of an inch from the end of the stave, thus neutralizing the effects of such imperfections in the wood as do not extend further than the depth of the slot, and secures an equal deflection of the stave, at the butt, and of the adjoining staves. The stave is thus square at the ends, having no projecting corners which can be easily damaged. And although the staves are slotted at the mill, it is no slight advantage that this slotting can be easily done with a common hand saw on the work, in case staves are cut.

The thickness of the stave depends upon the pressure of the water, the size of the pipe and the load upon it. The thickness required for various pressures must be determined by experiment. I know from experience that redwood of a thickness of 1⅜ inch shows no sign of the water oozing through under a pressure of 165 feet, and I am inclined to the opinion, seeing that every annular ring in redwood contains a very hard, flinty shell, of which there are some 20 or 25 to the inch, that that thickness will prove tight under much higher pressure. The diameter of the pipe and the superincumbent load determine the thickness of the staves, which act as an arch to support the load.

In attempting to calculate the required thickness of the wood for various diameters and top loads, we meet with the obstacle that the initial compressive strain in the wood, caused by the tightening of the bands, being one of the main factors, is rather uncertain and hard to determine, varying along the length of the pipe with the number of bands, and with the degree of swelling of the wood; I therefore take experience and experiments to be a safer guide.

The first wooden pipe built in Denver was 48 inches in diameter, and the staves were cut from 2-inch lumber, running about 1⅝ inch in thickness. Where this pipe was laid in good material it preserved its circular section, but part of it was laid in soft muck, and there the pipe became somewhat elliptical, in some places, with the long axis horizontal, in others vertical, as the loads on top or those on the sides were in excess. By dumping slag from the smelters, either alongside or over the pipe, it was restored to its original shape without trouble. This shows that here the safe limit for 2-inch timber was nearly reached for pipes which are to be covered two or three feet.

A 72-inch pipe was built on the Maxwell grant, in New Mexico, of 3-inch lumber, running about 2½ inches after dressing, and no flattening was observed.

The banding of the pipe is done in a manner similar to tanks, except that instead of flat iron bands, round steel is used. Herein lies the main difference between the stave pipes which have for years past been built in the East, and those which have during the last eight years been constructed in the West.

A pipe line, that at the time attracted considerable attention, was built by Mr. Fanning, for the water works at Manchester, New Hampshire, for water power purposes. It is six feet in diameter, banded with flat iron, and Mr. Fanning writes that it is in good condition. It was built in 1874, and is described in his treatise on water supply engineering.

The round form of bands is advantageous in as much as the life of the pipe is that of its shortest lived parts, which are the bands, although it is of course possible to replace old bands by new ones without abandoning the timber shell. Now the circle has a maximum area with a minimum of circumference, and thus offers the least possible surface to corrosive influences. Besides, the round form offers special facilities for joining the ends so they can be tightened with a single nut.

The question may be asked: why, if round bands are economical on pipe, they are not commonly used on tanks? This is due to the tapering shape of tanks, which allows the bands to be cut to exact lengths and riveted, and to be driven down from the narrow top of the tank without any other arrangement for tightening, the same as with barrels. It cannot be denied that a flat band has a better bearing on the wood than a round one, but that this larger bearing is entirely superfluous, I will endeavor to show further on.

These rods are, before being bent, simple straight bolts, with a head at one end and a thread and nut at the other, in length from three to five inches longer than the outside circumference of the pipe. They are bent on the work on bending tables, and then dipped in mineral paint or asphalt varnish, and hung up to dry several days ahead of the work of pipe laying. For large pipes two segmental bands are used, the rods otherwise becoming too long and heavy for easy handling.

The ends of these rods are joined together by means of a cast iron shoe, or saddle, of a simple form — several forms being in use. They are all shaped to fit the outside surface of the pipe for which they are designed. In each there is a shoulder for the head and a shoulder for the nut, the threaded end being made to lie over the head. Thus the strains on the shoe are not only as much as possible compressive strains, but they are all through the center line of the shoe, producing no tendency to twist, as is, for instance, the case with a casting in which the ends of the bands lie alongside each other. These castings can all be made at a low price per pound, there being no machine work about them.

CALCULATION OF STRENGTH.

To properly decide upon the diameter and spacing of the bands, we must understand the exact purposes for which they are put on. On a grade line pipe they serve the purpose of holding the staves together and securing the rigidity of the pipe and the tightness of the seam joints. There is an initial strain on the band when tightened, equal to the compressive strain in the wood. This strain is increased as the wood swells, when water is let into the pipe. The additional strain due to this cause, however, can never attain great proportions, as it increases very gradually, and is kept in check by the simultaneous adjustment of the fibre under the band. Finally, there is a strain on the band caused by the weight of the water from top to bottom of section, which may amount to about 16 pounds for 12-inch, and 2,074 pounds for 10 feet pipe, per lineal foot of pipe. Of all these strains, the one produced by the cinching of the bands is most important. In some cases the bands were spaced 18 inches apart with satisfactory results, on pipe under light heads.

For a pressure pipe we have to consider the bursting strain. No matter whether the shell be a mere coating of tar or asphalt, or a lining of cement, or wooden staves, a certain area of iron or steel is required on the outside to resist these strains, and in the case of wooden pipe it remains to so divide it over bands of the right diameter, that the staves may receive support with sufficient frequency to prevent excessive deflection between the bands, and excessive indentation at the bands.

The distance between the bands for bursting strain is expressed by the following formula :

$$(1.) \qquad l = \frac{2\,S}{d\,P}$$

l being the distance from center to center of band in inches.
S " the admissible strain on the band in pounds.
d " the inside diameter of the pipe in inches, and
P " the pressure of the water in pounds per square inch.

The distance between the bands, which keeps deflection of the stave at its weakest point (that is the butt joint) within $\frac{1}{1000}$ part of the span from band to band, is :

$$L = \frac{25.6\,h}{\sqrt[3]{P}}$$

h being the thickness of the stave in inches. Therefore, the condition imposed by the deflecting of the stave is :

$$(2.) \qquad l < \frac{25.6\,h}{\sqrt[3]{P}}$$

I give this formula rather to show the relation between distance of bands, water pressure, and thickness of stave, than that I would unreservedly recommend it for use. While it is based on a modulus of elasticity in relation to bending of 1,600,000—as given by Weisbach for wood, generally, which may be too high in the case of redwood—on the other hand, the limit of $\frac{1}{1000}$, the span for permissible deflection, is arbitrary. Experience has so far shown that where seam leaks have been found, they were clearly due to imperfect lumber, imperfect milling, damage to the stave in handling, or insufficient cinching of the bands, and not to excessive distance between the bands.

To a possible crushing of the fibre under the band, I have already referred. Redwood is but slightly indented under a pressure of 1,000 pounds per square inch, and I find that a rod may sink into the wood so as to get a bearing of 60° along its circumference, indenting the wood to a width equal to its radius, without perceptible damage to its fibre. The safe resistance of the bands against the staves thus being proportional to the diameter of the band, and the strength of the band being approximately proportional to the *square* of the diameter, it follows that if the required strength of the steel is distributed over four bands of one half the diameter, instead of being concentrated in one band of the full diameter, the safe resistance of bands against staves will be twice as large. Thus we can, by a proper subdivision, provide sufficient bearing for the staves. $\pi(d + 2h)$ being the outside circumference of the pipe, and r being the radius of the rod, it follows that $\pi(d + 2h)\, r \times 1{,}000$ equals the safe resistance, in pounds, of the bands against the staves. The pressure of the water against the staves is $\pi\, d P l$, therefore,

$$1000\, \pi\, (d + 2h)\, r > \pi\, d P l, \quad \text{or}$$

$$l < \frac{1000\, (d + 2h)\, r}{Pd}$$

or substituting for l the value in formula (1)—

$$(3) \qquad S < 500\, (d + 2h)\, r$$

That this condition is readily complied with, is evidenced by the following instances :

$$d = 12 \qquad h = 1\tfrac{3}{8} \qquad r = \tfrac{3}{16}$$

$$S < 1383$$

S being 1143 pounds for ⅜-inch rods, figured in the thread, with a factor of safety of 4.

$$d = 20 \qquad h = 1\tfrac{1}{2} \qquad r = \tfrac{1}{4}$$

$$S < 2875$$

S being 1960 pounds for ½-inch rods, figured in the thread, with a factor of safety of 4.

$$d = 54 \qquad h = 2\tfrac{1}{2} \qquad r = \tfrac{5}{16}$$

$$S < 9219$$

S being 4600 pounds for ⅝-inch rods, upset to ⅞ inch, and figured in the bolt with a factor of safety of 4.

This shows that flat bands offer no advantage over round bands so far as indentation is concerned, since the larger bearing they provide is superfluous.

MATERIALS.

The bands used are of mild steel with an ultimate strength of 70,000 pounds to the square inch for 3/8-inch rods, 65,000 pounds for 1/2-inch rods, and 60,000 pounds for larger diameters. When the rod is not upset, as is the case with the smaller diameters, we must figure the strength of the rod in the thread; and, it should be borne in mind, that since the strongest part of the steel lies on the surface, and is cut away by the die, the average strength of the remaining material is less than that of the full rod. I therefore deduct from the strength per square inch, in the case of 3/8-inch and 1/2-inch rods 10 per cent., and for larger sizes 5 per cent. Thus we get for the strength of bolt, in the thread, per square inch:

3/8 inch	63,000 pounds
1/2 "	58,500 "
Larger Sizes	57,000 "

The wood that has been used in the pipe lines in Colorado is redwood, Texas pine, and, in some instances, native lumber. In drawing up specifications for cast iron pipe the engineer calls for the best material, and does not admit blow holes, flaws, or other imperfections. There is no reason why the same care should not be exercised with wood; only well seasoned and perfectly clear, close and straight grained lumber, free from pitch, and with as little liability to swell and shrink as may be, should be specified. And there is no other, among the soft woods, that comes up to these requirements so well as redwood does; a fact which is beginning to be appreciated even in Colorado, where this kind of wood, owing to high freight charges, is quite expensive, the difference in price as compared with Texas pine being no less than $15 per thousand.

It needs no arguing that the lumber should be milled with the greatest exactness, both as regards the section of the stave and its ends. The lumber should be shipped in box cars, and at the point of destination should be piled up and covered, and not strung out along the trench until ready for immediate use.

The saddles or shoes should be of the best grade of cast iron, free from flaws, blow holes, or other imperfections. They should be rattled in a rumbler until they are bright and free from sharp edges, splints and tags.

MANNER OF CONSTRUCTION.

The erection of wooden pipe requires skillful and patient labor. The work proceeds about as follows:

U shaped, outside forms, usually of bent gas pipe, are put on two-inch blocks, and in these are laid the staves forming the lower half of the pipe. Then inside forms are put in position, on which are placed the balance of the staves, completing the circle. The staves are so placed that the end of one stave projects beyond, or falls back, 18 or 24 inches from the ends of the adjoining staves, so that the end of the pipe, during construction, presents a jagged appearance.

The bands are then put on and tightened, whilst the pipe is rounded out. After all bands are put in place at the proper distances and are securely cinched, this first section of pipe is ready to be extended in both directions.

The clips or metallic tongues are put in the slots, and the staves of the next section are put in place the same as before. The bands are put on, and whilst they are being tightened the staves are driven up with a heavy sledge and driving stick. The pipe builders are followed by back cinchers who give the final cinch to the bands. If the pipe is built in the trench, they in turn are followed by back fillers who tamp the earth under and alongside the pipe, and cover it. In this way one gang builds from 75 to 175 feet per day. On long pipe lines a number of gangs are put to work, and where they meet a buckle is made, by fitting the staves and springing them in. Connection with cast iron pipe or gates is made by means of special spigot and bell pieces, having large and deep bells into which the wooden pipe enters. The space between pipe and bell is caulked with oakum, or run with lead and caulked.

There should be air and check valves when there are summits on the pipe line for the emission and admission of air. The nipples for these valves are screwed in a hole in the wood, bored with a smooth cutting bit or auger. It is well to use lock nuts and oakum packing in connection with these nipples, although not necessary. Ordinary corporation cocks for taps may be screwed in, in the same manner.

For short irrigation siphons it is important, in order to save loss of head, that the entrance be made easy, and it is a very simple matter to give the end of the pipe a funnel shape, by inserting between the regular number of staves others planed down to a point.

It is suprising how easily this pipe can be made to follow, in a general way, the undulations of the ground, although the curvature to which it can be laid is, of course, limited. Thirty inch pipe readily follows curves of a radius of 250 feet.

CARRYING CAPACITY.

To my knowledge no accurate measurements have been made of the carrying capacity of wooden-stave pipe. I use the Kutter formula, putting the coëfficient of roughness n at 0.010, which Kutter, for open flumes of well dressed timber, states to be 0.009. Since it presents no joints or rivet heads to the current, and is otherwise perfectly smooth, it is plain that its carrying capacity must be greater than that of sheet iron or steel pipe, and that it greatly exceeds that of cast iron pipe. The inside remains smooth and clean, and there need be no fear of the capacity gradually diminishing.

COST.

The cost of this pipe is in the nature of the case closely dependent upon the pressure. Graphically we can represent the connection between cost and pressure, both for wooden and sheet-iron pipe, as shown in Fig. 3.

These diagrams have not been drawn to any scale or for any special size pipe, but are merely intended to illustrate the characteristic increase of cost with increase of pressure for each kind of pipe. It is plain that the shaded triangles represent cost of material required over that which is called for by the bursting strain for purposes of stiffness and rigidity. Although wooden pipe under high pressure may require as much, or even more metal than sheet-iron pipe, the reverse is the case with low pressure, as is still further shown in the following table :

Diameter Pipe.	WOODEN PIPE.			SHEET-IRON PIPE.		
	Diameter Bands.	Weight Metal	Safe Pressure. Factor of Safety 4.	Gauge Iron	Weight Metal.	Safe Pres're. Working Strain 10,000 lbs.
		Bands every 12 inches				
12	⅜ inch Straight.	2.5 lbs.	15.8 lbs.	No. 16	11.25 lbs	81 lbs.
16	⅜ " "	2.9 "	11.9 "	" 16	14.5 "	61 "
20	½ " "	6.0 "	16.2 "	" 16	18 "	49 "
24	½ " "	7.3 "	13.5 "	" 14	27.25 "	52 "
30	½ " "	8.6 "	10.9 "	" 12	44 "	54 "
36	½ " "	9.9 "	9.0 "	" 11	58 "	50 "
42	½ " "	11.1 "	7.7 "	" 10	74.5 "	48 "
48	½ " "	12.2 "	6.8 "	" 10	85 "	42 "
54	⅝ " Upset	23.6 "	13.2 "	" 10	95 "	33 "

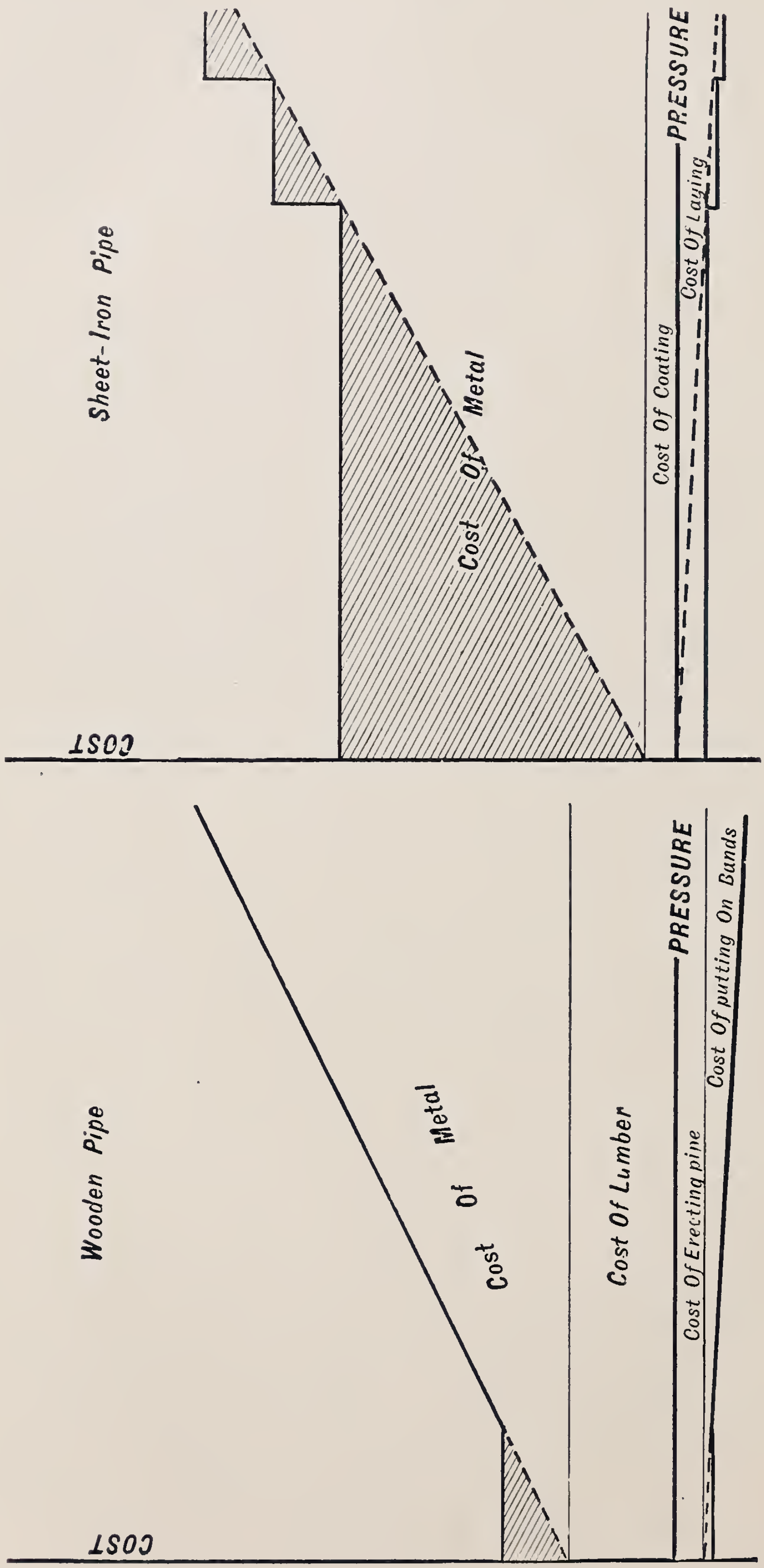


FIG. 3.

COMPARATIVE COST OF WOODEN AND SHEET-IRON WATER PIPE FOR VARYING PRESSURES.

The gauge of the sheet iron has been assumed as light as only the most favorable circumstance will allow, and the weights are based on straight pipe, with slip joints, and exclusive of the weight of the coating.

Beside the mere comparative weight of metal there enters a factor of comparative cost per pound. It is true that the actual cost of working sheet iron may be brought down to a low figure, but it requires expensive machinery, working only part of the time, and depreciating all the time. For the manufacture of bolts, such as are used on wooden pipe, no special machinery is required, bolts being a

FIG. 4. 37-INCH PIPE AT DENVER, COL.

staple article in the market. And the tools needed for erecting the wooden pipes are few, simple and cheap. It must also be remembered that the comparison of cost should take into account the comparative carrying capacity, which, where prices seem equal, makes wooden pipe between 5 and 10 per cent. cheaper per gallon of water carried than sheet iron.

FIG. 5. 14-INCH PIPE AT PROVO CITY, UTAH.

As it bears on this subject, I wish to quote from a report made about a year and a half ago to the Pueblo Gravity Water Co., by one of our members, Mr. James D. Schuyler.

"I have recommended the use of 5,630 feet of 30-inch, and the remainder, 70,140 feet of 24-inch pipe, to be made of California redwood staves, built continuously in the trench and banded with round steel bands. This recommendation has been made for the following reasons:

First.—After thoroughly investigating the history of wooden pipe as laid for seven years past in Colorado, and after examining a number of lines in use, I have come to the conclusion that if the bands are properly coated and the pipe kept full of water it is practically indestructible, and certainly has a longer life than sheet iron or steel riveted pipe.

Second.—The interest on the *difference* in cost between wood and cast iron pipe of the same capacity will replace the wood pipe every ten years, which I think is but a fraction of the life of wood pipe, and therefore it would be a prodigal waste of money to put the amount of capital necessary to lay cast iron mains into the enterprise.

Third.—The wood pipe is cleaner, does not become foul, does not rust, does not fill with tubercles that diminish the capacity year by year, has no yarn to rot and contaminate the water, will not break by settlement, will not burst so readily under water hammer, and so long as it lasts is, in every respect, cleaner and more desirable.

California redwood is so much better adapted to that purpose than any other wood available, that I recommend that material."

For the 16 miles of 30-inch wooden pipe, built by the Citizens Water Co., of Denver, two years ago, the comparative figures of cost, roughly stated, are about as follows:

Actual cost, wooden pipe	$160,000
Estimated cost, riveted iron pipe	333,000
Estimated cost cast-iron pipe	717,000

This line of pipe is almost entirely under a pressure varying from 50 to 220 feet. It was built of Texas pine. If redwood had been used, as it will be for all new pipe lines now contemplated by this company, the cost of the wooden pipe would have been about $185,000.

PIPE LINES IN USE.

Besides a number of short irrigation siphons in Colorado and New Mexico, varying in diameter from 24 to 72 inches, there have been built, during the last eight years, the following pipe lines, arranged in chronological order:

3.2	miles	48	inch pipe	Denver Water Co.
5.75	"	37	" "	" " "
1.	"	30	" "	" " "
1.25	"	24	" "	" " "
3.	"	12	" "	" " "
2.	"	25	" "	" " "
0.5	"	48	" "	City Ditch, Denver.
0.75	"	30	" "	Cheyenne Water Works.
1.78	"	24	" "	" " "
1.13	"	24	" "	Irrigation purposes near Denver.
3.	"	12	" "	East Denver.
0.8	"	54	" "	Irriga'n siphon, Bessemer Ditch, n'r Pueblo, Col.
5.	"	24	" "	Ogden (Utah) Water Works.
16.	"	30	" "	Citizens Water Co., Denver.
3.13	"	12	" "	Aurora Water Works, near Denver.
6.5	"	30–18	" "	Perris Water District, Cal.
3.75	"	14	" "	Provo City (Utah) Water Works.

The pipe lines at Cheyenne were constructed in a poor manner and of cheap material, and have not given satisfaction.

Note.—The pipe built for the Perris Water District is slightly different from the other pipes mentioned, in that it has the edge of the staves dressed in a V shape, instead of flat.

CONCLUSION.

Before a body of engineers it is unnecessary to state to what purposes this pipe is adapted. Yet I wish to call your special attention to its comparative cheapness under light heads. Long gravity mains for domestic supply can often be located so as to keep the pipe close to the hydraulic grade line. It offers advantages, regardless of its cost, which commend it particularly to irrigation engineers. And that it is applicable to the development of water power and to hydraulic mining will be readily understood.

DISCUSSION.

PROF. KEITH.—The paper read this evening recalls to my mind that in 1863 I had occasion to build a species of wooden pipe for carrying water through a mill building on Clear Creek, near Black Hawk, Colorado. The building stood on a side hill, and before the pipe was used the seepage from the ditch, which was first used to convey the water, was a source of annoyance. The pipe was built with tapering ends, so that one length fitted into the mouth of the next length of pipe. The bands were made to different sizes, and driven on to the pipe to sustain it. This pipe though a somewhat crude device answered our purpose excellently, did not leak at all, and was in use for the four or five years I was there, and may be so still."

PROF. SOULÉ— "What care is taken to place bands over the joints where the iron plates are inserted?"

MR. HENNY.— "The pipe is built, more or less, in sections, and at places where the joints come we usually put one extra band, but we do not pay any attention to the bands being placed right over the joint."

MR. ALLARDT.— "How do you manage where pipe lines branch or cross?"

MR. HENNY.— "Cast iron specials are used with large and deep bells. The wooden pipe enters the bell, and the space between the pipe and the bell is caulked with oakum or with lead."

Q.— "How long do you make the staves?"

A.— "All the way from 12 to 20 feet."

Q.— "Is it necessary to have special machinery for making staves?"

A.— "We have special machinery for cutting staves for tanks; all that is required besides is machinery for slotting the ends."

PROF. SOULÉ.— "Did I understand you to say the pipes remain perfectly clean and free from vegetable growth or fungi?"

A.— "Yes. Most vegetation in the water requires light, and of course that is excluded."

Q.— "Have you ever noticed any special eroding or working away of the wood after pipes have been in use?"

A.— "Our experience with this stave pipe is not long enough to say. I have heard of 4-inch bored, log pipe that when taken up measured 5 inches. I suppose, however, that such wearing away takes a long time, a high velocity of the water, and presumably grit or sand in the water."

Q.— "Do you put any preparation on the wood, inside or outside, to preserve it?"

A.— "No sir."

Q.— "Do you prefer seasoned wood?"

A.— "Yes, in all cases, to prevent shrinkage after it is milled. Most of the wood is kiln dried."

Q.— "The best form of stave, after all, is the straight edge, is it?"

A.— "That is my opinion. We have never had any trouble with the seam joints, except where one could distinctly see some defect in the stave, but experience has shown that the pipe must be carefully built to be thoroughly tight."

Q.— "What is the smallest size of pipe made of staves?"

A.— "The smallest size is 12 inch. I am now building at the works some 6-inch pipe. I have used staves out of one-inch lumber reduced as low as half an inch in thickness at the joints, and it makes a very stiff pipe."

Q.— "I suppose from that size up you can build as large as is required for practical purposes?"

A.— "A seventy-two inch pipe line built on the Maxwell Grant is the largest constructed so far, but there is no difficulty in building larger diameters if required."

MR. ALLARDT.— "Has any of this pipe been used for sewer purposes?"

A.—"Not as far as I know."

Q. "In a general way how does the cost, including the very large pipe, compare with the cost of sheet iron, or sheet steel?"

A.— "The cost of this pipe is dependent upon the pressure. Ten feet pipe, built of 4-inch lumber, banded with 7/8 steel bands 12 inches apart, is listed, including laying, at $13 a foot. Twelve-inch pipe with bands every foot at 80 cents, laid. The freight, if the pipe were to be used some distance from San Francisco, would be added, that is, on the lumber. For Eastern points this would be partly balanced by a saving on freight on the bands. The bands are sent direct from the factory to the place of destination, so the wood from San Francisco and the iron from the East meet at the work for the first time."

Q.— "Is it well determined that the wood does not rot on the outside of the pipe?"

A.— "Mr. Hull, an engineer in Connecticut, having built a good deal of this pipe, writes, after 40 years of experience with wooden pipe, that if the pipe is laid above ground and kept full of water its life would be about forty years, but if laid underground and covered over he considers its life indefinite, there being no rot to it."

PROF. SOULÉ.— "I have a piece of bored log pipe which was buried in the ground for 15 years, and used for carrying water for domestic purposes. You can scratch the outside anywhere, and the redwood is perfectly sound. The bore I think is two inches, and the log is about 4 inches square. I mention it simply to show the durability of the wood. It was not decayed in the least. I think, in this case, the wood, while the pipe was in use, was completely saturated with water."

Q.— "How are the bands protected?"

A.— "They are coated with paint or asphaltum. In case the bands should rust off in the course of years, new bands could be put on between the old ones, and the staves saved."

Q.— "Have you had experience with these pipes when laid on the surface of the ground?"

A.— "No sir, in Colorado these pipes are laid underground to avoid freezing of the water in cold weather."

Q.— "Is the wood surfaced on both sides?"

A.— "Yes sir."

Q.— "How much does the mill charge per thousand feet, board measure?"

A.— "Thirty-three dollars."

MR. VISCHER.— "I would like to ask Mr. Henny whether he has ever examined wooden pipe carrying water, to determine to what depth the wood was saturated with water?"

A.— "I have examined pipe with 1⅝ inch of shell, under nearly all pressures up to 165 feet, have cut into the pipe and found the wood looked damp, but did not show any signs of water oozing out."

MR. VISCHER. — "This pipe would, I think, derive certain advantages from the smoothness of its inner surface, in a capacity to withstand freezing of the water carried by it, when exposed to great cold. This is often a serious drawback to the use of iron pipe in cold climates, especially where supervision of the line is difficult. Freezing of the water is generally not directly brought about by the water being frozen at the point where stoppage takes place, but by the lodging of "scum" or "float" ice against surface obstructions in the pipe, which form initial points from which, by subsequent accretion, the whole area becomes closed. My experience was with iron pipes not larger than 8 inches diameter, and larger pipes, probably, are less liable to stoppage by freezing. However, the smooth and uniform inner surface should be an advantage, besides the greater thickness of the wooden shell of itself aiding in resisting cold. I think wooden pipes might be laid at less depth than iron, which advantage is often material when frozen pipe lines have to be hurriedly uncovered.

The correct thing is, of course, to put the pipes deep enough in the ground from the first, so that freezing will not take place, but this is not always easy to accomplish. Merely laying pipes below the frost line is not a guarantee against their becoming frozen.

In case of freezing, the remedy usually is, after locating the frozen section and uncovering the pipe, to build fires under it, by which process pipe is often burned and the iron much injured wherever the stoppage, instead of being continuous, consists of patches of ice, with empty spaces between them. Pipe which has been so heated several times, has its life pretty well exhausted. If the stave pipe should become stopped by freezing, it seems to present facilities for opening up a section by loosening the bands and removing the obstruction without damaging the pipe."

MR. HENNY.—"Mr. Vischer is right, I think. In Utah, we covered this pipe with two feet of dirt, and the cast iron we covered three and a half feet. So far we have not had any stoppages from freezing. I built a main line of 12-inch cast iron in South Dakota, and covered it seven feet. In the Northern Peninsula of Michigan we covered the pipes seven feet and over, and I heard after I left they had considerable trouble with freezing of the mains. In Denver the mains are covered about four feet; in Leadville, eight and one half feet."

MR. ALLARDT.—"There is a royalty on the pipe, is there not?"

A.—"Yes, but it is merely nominal. Mr. Allen, who had the patent, has given us the right for this part of California and for the Western States."

Q.—"In building a line of pipe, how much care do you have to take in laying it to exact grade before tightening the bands and filling the trench?"

A.—"The pipe is laid to the trench as graded, and the bands then tightened. We do not dig the trench wider than we can help, and we aim to have an equal space on each side of the pipe to work in."

PROF. KEITH.—"How about expansion?"

A.—"I have always laid this pipe in a trench, and have taken pains to have it back-filled immediately after construction, so that there would not be great changes in the temperature of the pipe. Where the pipe had been exposed I have never noticed any expansion. As regards expansion caused by saturation, the swelling of the wood lengthwise causes the butt joints to become perfectly tight."

Q.—"Have you ever had trouble from animals and rodents knawing the pipe in pursuit of water in a dry country?"

A.—"I have never known any trouble from this source."

PROF. CARNOT.—" It gives me extreme pleasure to be with you tonight. I am very glad to have had one opportunity during my trip through America of seeing some society of this kind, and the tone and scope of the discussion of its papers. I must say I have been very highly gratified. The subject is entirely a new one to me. It appears to have been handled in a very able and thorough manner, and there is much food for reflection. I would have liked, however, to have had a few more figures in regard to prices for comparison of its cost with that of other kinds of pipe.

As far as I am aware, we have no wooden pipes in Australia. Up to a few years ago we used cast-iron pipes, then an innovation came in the way of wrought iron, and that is now extensively used. During the past five or six years there is an entire cessation almost of the use of cast-iron pipes. In Melbourne we have works where machinery is used for manufacturing wrought-iron pipe, and it is turned out in large quantities. One point of interest to me, and one I have never been able to get any satisfactory information upon, namely, as to how far the lap of the plates and the heads of the rivets impede the flow of the water.

This timber pipe is quite a novelty to me, and the idea of making a large water main out of timber comes to me certainly in the light of a revelation. The question that suggests itself to my mind, of course, is how far is it applicable to the conditions that exist in Australia? We have a very small supply of pine wood; all our wood, as a rule, is very hard indeed, and intensely hard after it is seasoned. Here, as I understand, you have a pipe which is cheaper than either cast or wrought iron, which, as far as can be seen, is equally durable—at any rate, quite as durable as wrought iron—for I presume, the bands could be protected as well as the iron of wrought iron pipes could be protected. We are told, that as far as seen, when underground it is cleaner and smoother than cast-iron pipe, and, of course, much more so than the wrought iron. It certainly seems as if it were a great improvement, and was likely to be of very great value indeed. Knowing nothing about the subject practically, myself, I cannot add anything further, except to say that I feel very pleased indeed with the paper, and also with the discussion. It seems to me that it is a very marked advance in connection with water supply matters.

Of course the question of how it would do for sewerage is of still further interest. We are about to expend several millions of dollars upon sewerage works in Melbourne. It would be interesting to know if pipe of this description would answer the purpose.

There is another pipe I would like to put in comparison with it, and that is the earthenware pipe. It is comparatively cheap ; it is very smooth and cleanly, but will not stand a very great pressure. We have used it to some extent for carrying water supplies, and with some success. But for sewerage purposes it is universally used. Perhaps the use of wooden pipe for sewerage purposes is a little remote.

I thank you for this opportunity of addressing the meeting ; I only regret that my departure for Australia on the steamer tomorrow will prevent my meeting with the members and becoming personally acquainted with them."

Q.—" Is not the use of earthenware pipe naturally a restricted one for water supplies, on account of the inability of the joints to withstand 'water hammer' ?"

Prof. Carnot.—" Of course we only use it under circumstances where 'water hammer' can be guarded against. I have known, however, of earthenware pipe being used with success in conducting water for small towns, for instance where water has been taken from an aqueduct, a distance of several miles to a surface reservoir, metal pipes being used to conduct the water from the reservoir to the town."

Mr. Vischer.—" While not strictly pertinent to the subject of wooden pipe, I would like to ask if any member is able to express an opinion as to the relative merits of steel and wrought iron as regards durability. Perhaps Mr. Dickie has some data upon this subject ?"

Mr. Dickie.—" I think durability would be in favor of the iron ; it would depend, however, mainly upon the coating. When the coating is gone the life of the pipe is very short, as we all know in handling pipe.

I have listened very attentively to this subject tonight, but there is one thing I must say I cannot understand. In this wooden pipe it is not claimed that the wood presents any resistance to the pressure ; therefore it is no factor whatever in the strength of the pipe. If the wood is banded by steel, there must necessarily be as much steel in the bands as would make a steel pipe of the same strength. Now, steel formed into bands with a head on one end of the band and a nut on the other will certainly cost as much as manufactured steel pipe. Under these circumstances I do not see how the wooden pipe can be made cheaper. I am talking about a pipe under pressure. The thickness of the metal is dependent upon the pressure it has to stand. Now I take it that the bands of a wooden pipe, under a head of 200 feet, would cost as much as a steel pipe carrying the same head. I think the cost of manufacturing steel into pipes in San Francisco is not more than seven eighths of a cent per pound, and that would be the amount that you would have for manufacturing the bands and making them ready for use in supporting the wooden pipe. The thread cut in the band takes out about the same amount as is taken out of a double-riveted iron pipe, so that the amount of material would be absolutely the same. I am not clear about the relative cost of pipe as represented by Mr. Henny's diagram; the difference, however, appears to me too much. As regards the steps shown in the diagram, when material is ordered for pipe at the mills, the increase of the thickness of the pipe is a very small factor. I know of instances where the variation in thickness of metal is very small indeed as pressure increases. I think this can be regulated as closely as the spaces between the bands of wooden pipe."

MR. HENNY.—"In answer to Prof. Carnot's remarks regarding exact figures as to the cost of this pipe, I can give list prices, quoted by the Excelsior Redwood Co. They are for pipe, banded every 12 inches and include cost of erection:

12 inches	....	80 cents	36 inches	....	$2.05	72 inches	......	$ 5.60
16 "	......	$1.00	42 "	....	2.35	84 "	......	7.25
20 "	....	1.30	48 "	....	2.65	96 "	......	9.60
24 "	....	1.50	54 "	....	4.35	108 "	......	10.80
30 "	....	1.75	60 "	....	4.80	120 "	......	13.10

Professor Carnot thinks that wooden pipe is about as durable as wrought iron pipe, but it appears to me reasonable to suppose that its life is much longer. As Mr. Dickie remarks, when the coating is gone the life of sheet iron pipe is very short. This holds good for those parts of the pipe where the coating has been knocked off, or is cracked, or is imperfect. For, under ordinary methods of pipe laying, who can guarantee absolutely perfect coating after the pipe is laid? Now the slightest imperfection in the coating leaves but from $\frac{1}{20}$ to $\frac{1}{12}$ of an inch of short-lived material to rust away, in order to have a leak. If one could keep sheet iron pipe tight, notwithstanding its rusting through in spots, until enough metal is worn away to make the pipe burst, then its life would approach that of wooden pipe. On the grade line, I agree with Professor Carnot that vitrified sewer pipe is to be preferred to wood. But, I think, the largest size manufactured is 30 inch, and at that size it becomes very expensive. Then it must be kept to the exact grade line, as the cement joints cannot be depended upon under even slight pressure.

In comparing the diagrams of cost, Mr. Dickie appears to misunderstand me, as I do not claim that under high pressures wooden pipe is cheaper than sheet iron pipe. I believe to have called your attention this evening to the fact that no matter what material is used for the shell, the same amount of metal is required in either case to resist the bursting strain. What I attempted to show in the diagram is that, over and above this amount, there is required considerable metal in the case of sheet iron pipe under low pressure, simply to make the pipe stand up under outside pressures. It is under light heads that wooden pipe has the advantage of cost over sheet iron pipe, but it has the advantage of durability under all pressures."

Mr. Vischer.—"The longitudinal stiffness of the wooden lining should make the pipe self sustaining for certain lengths when carrying water, thus making it available for support on trestles if desirable. This may not often become necessary, yet I have known a case in the Sandwich Islands where this quality, if it exists to any extent, would have been highly in its favor. A swamp, with rock bottom, was overlaid by oozy, almost fluid mud, two to four feet deep. Trenches could not have been dug, and by far the simplest method would be to lay the whole pipe on low horses above the mud surface. Here all the material would have had to be packed on the men's backs for several miles, and the extreme lightness of the parts of which the stave pipe is built would have greatly recommended it. In fact, this quality should not be under rated, for lightness of parts is often more essential, where transportation is difficult, than lightness per foot of finished pipe."

ENGINEER CORPS, U. S. ARMY.

To the Technical Society of the Pacific Coast:

Having received the following communication from our distinguished Past President, Col. George H. Mendell, Engineer Corps, U. S. Army, I feel it incumbent on me to present it here with Colonel Mendell's consent, and in accordance with the suggestion it contains, to offer such personal explanation as the circumstances call for.

Colonel Mendell's communication is as follows:

"Mr. John Richards,
President of the Technical Society, San Francisco, Cal.

Sir:—In the annual address to the Society of which you are President, read on January 15, 1892, the following remarks occur:

"'The improvement of rivers and harbors by the general government I think had better not be mentioned. So far as this Coast is concerned there seems no complaint, but on the Atlantic side the record is not one to call for commendation, when compared with the achievements of private enterprise.'"

My acquaintance with the improvements of rivers and harbors on the Pacific Coast permits me to say that there is no reason, relating to the works themselves, why they may not properly be mentioned and discussed. The engineers responsible for the works not only can have no objection, but would doubtless favor thorough discussion.

My acquaintance with works of this character on the East of the Rocky Mountains is less close. I know, however, many of the engineers who ha e now, or have had charge of these engineering works to be men of character and ability.

The opinion which you express, to the effect that these works are not worthy of commendation, is not the one generally held, and is, I am assured, a mistaken view. If it were otherwise, the direction of these works would long since have passed into other hands. But you appear to have reached your conclusion after study, implied by your references to a record.

You may be in possession of information not generally known. The subject is one of general interest, and of great importance. The reputation of a worthy class of men is assailed by your statement.

You will therefore doubtless perceive the propriety, upon request now made, of laying before the Technical Society, or otherwise making public, the facts which, in your opinion, justify the disparaging assertions and implications contained in the quoted statement.

Very respectfully,

(Signed.) G. W. Mendell."

*A communication read at the regular meeting of the Technical Society of the Pacific Coast March 4th, 1892. Republished by permission.

In respect to this communication, and the subject incidentally referred to in the address, the works in question are matters of national and general concern, and involve features quite distinct from and independent of the ability of the Engineer Corps, which it was not the intention to call in question at the time of writing the sentence quoted from the annual address.

The words used hardly call for this disclaimer of any intention to reflect upon the personelle or qualifications of the Engineer Corps. If so, full apology is now made, but as before said, the works are of public concern, subject not only to the criticism common to all such undertakings, but in greater degree, because executed outside of what may be called the profession in general.

My impression cannot therefore be considered as carrying other weight than that of personal opinion, and as such, liable to error; especially as in this case the subject pertains to a branch of engineering work with which I am not familiar.

There was in the use of that term "record," no intention of declaring information, except in a limited degree, other than is open to everyone in the technical and secular literature of the time; in this sense the term record was employed.

It must be admitted, even by the Engineer Corps and their friends, that serious criticisms of many of the river and harbor works on the Atlantic side of the country have appeared recently in journals of good, or even high standing, and at times over the signature of civil engineers of wide repute.

I do not think it necessary or expedient to cite references generally accessible in current technical literature, or to seek support for my statement in such expressions as those contained in a recent report to the St. Paul Chamber of Commerce by a committee of theirs, on the works carried out on the Upper Mississippi River.

Such presentations here would perhaps lead to a spirit of controversy, undesirable and unnecessary if Colonel Mendell will admit that such published matter was sufficient to call out the expression used in respect to government engineering works on the Atlantic side of the country, especially as at the time of writing no reply had been made to some of the most serious of the charges presented.

I think it due to Colonel Mendell to say that since receiving his communication, some inquiry among the profession here develops the fact that his own administration on the Pacific Coast has not only escaped criticism among the profession generally, but earned both approbation and admiration.

As even errors and mistakes can have a useful side, so it may be in this case, if the criticisms of public works will bring to the notice of this Society, the points in controversy between the private and government engineers in the East, especially if such consideration will induce Colonel Mendell and his staff to lay before the Society information respecting works under his administration, which will have an especial interest to the members.

February 22d, 1892.

Since the preparation of the foregoing communication I have received from Colonel George H. Mendell documentary evidence of both a public and private nature, showing beyond mistake that not only have the works in the upper Mississippi been beneficial, but that such works have met with commendation from all but a few sources among those interested.

The papers submitted by Colonel Mendell are:

(1) A communication from Major A. Mackenzie, in charge of the Government work on the Upper Mississippi River.

(2) Communications to Major Mackenzie from some of the principal steamboat lines, accompanied in some cases by records and dates of a character to show an improvement of the channels, and commendatory of the works carried out under the Corps.

(3) Private letters by shipping firms, asserting that the works under Major Mackenzie's administration, have been of great benefit to the interests of navigation.

(4) A communication from C. C. Andrews, Chairman of the Committee on the Mississippi River, St. Paul Chamber of Commerce, stating that the resolution passed by the chamber on Dec. 10th, 1888 was a mistake in so far as being a concensus of opinion in that body, having been withdrawn or rescinded by a subsequent resolution passed on the 17th of December succeeding; also saying, that the Government Engineer Officers enjoy fully the confidence of that Chamber.

(5) Quotations from the Editorial Columns of the "St. Paul *Pioneer Press*," of Dec. 12th, 1888, condemning and denying the allegations set up in the resolution passed by the Chamber of Commerce on Dec. 10th, 1888.

The copious nature of the public portion of these various documents prevents them being presented here, and it is not necessary, as

Colonel Mendell indicates, further than to, on my part, concede the error of the statement at first quoted from my annual address.

My information respecting the Government engineering works on the upper Mississippi was mainly of an *ex parte* nature, derived from private sources and from newspaper clippings with dates removed, but left to inference as being current.

I think that the substance of these remarks, spread upon the minutes of the Society, will very fully eliminate any effect produced by the remarks in the annual address.

As the editor of a publication dealing to some extent with engineering matters, perhaps my opportunities for observing the untruth and unreliability of floating news is greater than with most members of the Society, and I take this occasion to say that the untrue and inexact part is the main one.

San Francisco, March 4, 1892. J. RICHARDS.

THE TECHNICAL SOCIETY OF THE PACIFIC OOAST.

At the regular meeting of the Technical Society, on March 4th, 1892, Dr. R. Heidrich addressed the members on the subject of Mnemonics, and its usefulness in mentally retaining data and formulæ. Examples were given to show the simplicity of impressing the mind with a subject, connecting this with any other fixed in the mind, and calling up that subject, thereby, at any time. Dr. Heidrich had committed to memory the first fifty logarithms to seven places of decimals, and repeated them at the pleasure of the members to any desired natural number.

The interesting subject was discussed, after which a vote of thanks was passed for the author. This lecture will be published in a subsequent bulletin of the Society.

The Nicaragua Canal Committee having been requested to make a report in the near future, the Chairman of that committee announced that one would be submitted at the next regular meeting.

The following new members were elected :

Conrad Eimbeck, Civil Engineer.............Guaymas, Mexico.
D. C. Henny, Civil Engineer............ ....San Francisco, Cal.
Alex. M. Reynolds, Civil Engineer...............Seattle, Wash.
Arthur H. Sanborn, Ass't City Surveyor ......San Francisco, Cal.

Four new names were proposed for membership and referred to the Board of Directors.

EXTRACTS FROM A NOTE BOOK.

[BY "TECHNO."]

No. XIV.

————We went around to visit some of the Slöjd schools here in Gothenburg, and the name calls for a digression. The letter 'j' in the word is not the grating Latin or French one that sets one's teeth on edge, but is simply 'i,' long. They call it 'i' and put a dot over it. When I say 'i,' don't understand that letter in our English tongue, which of all other letters is the most awkward to pronounce—a sound that is unnatural if not repulsive. I mean long 'i,' nonexistant as a sound, I believe, in any other language. This letter is 'e' long in all tongues but our own, so 'j' is simply 'e' long.

This explanation I make on behalf of those poor wits who make jokes on such names as "Björnson," which is spelled as rationally as "Smith" or "Jones." Björn is "bear," and Björnson is the son of a bear, or of a man by the name of "Bear," to be more exact. In order to understand this matter, one must keep in mind that Scandinavian etymology and syntax are rational and systematic, and English are neither. I could go on and show how 'i' or 'j' became metamorphosed into that saw-filing sound we give to the letter, but it is of no use, and what is of more interest is to note that Scandinavian names always, or nearly always, mean some natural object, such as mountains, rivers, streams, animals, and so on, while in Saxon lineage we have handicraft, such as weaver, carpenter, smith, and the like. Scandinavian names are an interesting study, and will be found, in nearly all cases, to contain a "root" as above. Berg, (mountain); ström, (stream); löf, (leaf); örn, (eagle); ek, (oak), are examples.

The alphabet contains twenty-eight letters, counting the modified vowels ä, ö and o̊. The latter is long o. These twenty-eight letters have one sound each, no more, no less, and where an assemblage of them makes up a word, one knows what to call that word.

Some years ago it was discovered that the letter 'c' was superfluous in the Swedish language, as it is in English, and it was cast out. The academy of something, at Stockholm, requested all writers and printers to omit this letter, and the thing was done. In America, or England, the people would at once have doubled the number, if such a request had been made. This useless letter 'c,' which has in English the sound of 'k' and of 's' but no sound of its own, had smuggled itself into about fifty words of the Swedish language, taking the place of 'k' at the beginning of words, in which connection only it was found. It is gone now in Sweden, and let us hope will be gone some day in English as well.

————Reverting to schools in Sweden, my own notes, while they may be in better diction, do not compare to my Uncle's comments when he can be persuaded to talk. It seems this school matter has interested him in some way, at any rate he understands it, as will appear from the following, jotted down from one of his lectures.

"Schools?" said he, "Any one who visited the Vienna Exhibition, or any other exhibition for that matter, where there were school exhibits, will know what schools are in Sweden. Why, a child learns its letters and to spell in four languages all at the same time, and learns the whole much better than one and almost as easy. The girls learn to make their own clothes and to make bread, as well as the piano and deportment. At two in the afternoon they sing. Sing! I say, not 'squawk.' Sing so that visitors come to hear the music, just as they would go to a concert. I am speaking of elementary schools now. At some hour in the day the boys are called out for 'drill' in a gymnasium, by the 'Ling' system they call it, after some man who connected calisthenics to science. There is no rough and tumble business, but strict drill, by an officer of the army usually, who is detailed for that purpose. It is a wonderful performance, better than a theatre, and of infinitely more use. I am not a schoolmaster, nor the custodian of boys, but I know a school when I see one, and they can be seen here.

These people are housed in the winter in close rooms. Ventilation is estimated by the cubic foot; a foot of air and a foot of cold, they come in together, but, nevertheless, as you may see, the people are sturdy and strong.

Besides the elementary schools, or the secular schools, there is in every town of any size a technological school, and filled up too. Take Jönköping for example, an inland town, on Lake Wetter, with about ten thousand people. There is there a technical school or college equal to some of our best, so are there all over Sweden, and have to be.

What are these people to do on this poor peninsula that produces mainly granite, stunted pine trees and ice, with a few cereals, such as rye and oats? The people must go 'outside' to hunt for a living, and to do this must know something. Formerly they were driven out by law, that is, a large part of the boys were, who found the law congenial because it gave a kind of warrant for robbing the coasts of the English Channel and everywhere else they could reach with their boats. Schools they must have in this day, and then when they go out into the world they soon learn the practical part of what they have already the rudiments and theory. Those that learn trades here stay at home, and now-a-days very few but the peasants or poor farmers leave this country. By the way, it is a strange thing, and a fortunate one, too, that the poorer a country is the stronger the people's attachment to it. This poor frozen land, with night twenty-one hours long in winter, and land that an American farmer would not think of cultivating, is to the Swedes home, and beautiful. *Gamla Sverige* is the refrain of their songs, the subject of their poems and traditions. The particular blessed spot of the earth."

———The foregoing, taken in all, is the longest and most moderate speech my Uncle has made. It is owing to the somnolent environment of the country. No one is in a hurry here. There is not quite as much "tomorrow" as with our Latin friends, but near it. Tomorrow we start through the Gotha canal for Stockholm on one of the little iron steamers that run in that trade. There are about a hundred of them, and among these a dozen or more fine packets for passengers.

———At nine o'clock we cast off, and our little steamer began ascending the Gotha River, or a branch of it, because when we were fifteen to twenty miles out we came to a high hill, on which was an old castle in ruins, and on passing around that, came to where more than half of the river struck off in a northern direction to the ocean by a shorter route. Some farther on we came to the first rapids and went through some locks, or sluices they are called here. This fall is a small one, of only ten feet or so, but in an hour more we ran into a great pool overhung and darkened with timber, and resounding with a roar like Niagara. This was the foot of Trollhätta (witch's hat, or cap), the greatest waterfall in Europe, where 80,000 cubic feet per second come tumbling over ledges for a height of 109 feet. The whole rapids are 5,000 feet long, but there is one clean jump at the head of 40 feet or more. It is a remarkable place. Wild, weird, noisy and grand will do as adjectives, but what astonished me most was to see our little steamer, which we had abandoned, slowly "climbing the hill" at a right angle to the river. We followed up the boat, fearing it would diverge off into the country, but it kept straight on, lift after lift, until it was 110 feet above the dark pool from which it started. We all clambered up the hill and on board again, and started in the first stretch of artificial cut, or canal proper. The whole of this great work of the sluices is not made in the usual way of built up masonry. It is "carved out of the solid granite."

Now that we are in the real canal, I will explain something of it. It was not a very rapid work. They were 400 years in making it, or a part of it at the eastern or Baltic end. The western end, from Lake Wenner to the North Sea, was completed in 1800, or nearly 300 years after the scheme was first considered, and after more than 100 years of actual work, some of which was lost, because there is a lot of unfinished cutting at Trollhätta, up alongside the falls, that was abandoned. The canal may be called a series of links, or sections, connecting lakes. Sweden is covered with lakes, and contains the two largest in Europe, Wenner and Wetter, through both of which the line of the canal passes.

The extreme altitude attained is 300 feet, at *Viken*. There are 74 locks, 37 on each side, and they are "there to stay." Some of the work looks queer and primitive to modern eyes, but, for the time, was done as well as human knowledge would permit. Telford, the great English canal engineer, was, for a time, engaged on the work. There were, of course, many engineers. It takes quite a number to last out a 400-year job like that.

It is 300 miles or so by canal from Gothenburg to Stockholm, which is 270 more than I inferred from the distances set down here. Swedish miles, contrary to the usual laws of expansion and contraction, have in this latitude lengthened out to six times one English standard, and one must keep this in mind traveling here. The time is about three days in all, by steamer, and the trip one of the most enjoyable that exists. The meals or food is in a measure *a la carte*, and you keep your own account in a book hung up for that purpose. At the end of the journey you foot up your own account, and pay the Mam'selle in charge. There is no cheating, or thought of cheating. There is no energy to waste on such things here. It is not agreeable. It don't pay, as we would say. The labor and anxiety of bargaining and watching to avoid cheating is a heavy load, and these people seem to escape it somehow, as my Uncle has already explained. It would be a curious problem if we could know just what part of human effort is directed to the avoidance of being cheated. It is a considerable part, and includes much more than we suppose.

The money here is at first a little confusing, like the "reis" of Portugal, but when learned is a very plain and sensible system. The unit is a "kroner," worth twenty-six cents of our money. This kroner is divided into 100 parts called "öre"; so that when one is informed that a cigar is fifty öre, the statement calls for surprise. There are little silver coins of five and ten öre, also copper coins of small value, but the main currency is paper money of the most sensible kind I have ever seen. The bills of small denomination are about the size of a common letter envelope, 3 × 5 inches, and form a convenient pocket size. Their denomination is indicated by unmistakable marks, so there are no errors in counting. Larger bills are just double this size, so as to match when folded once.

I had no trouble in paying accounts, for, as my Uncle suggested, I hand over the money at hand and the seller takes out what is coming to him and returns the rest. No one wants to cheat you. No one thinks of such a thing.

This is the strangest navigation I have ever seen, and so remarked to my Uncle as we were entering Lake Wetter. "Strange," said he, "You should be here some time when a squall comes down on this pot hole. Why it picks the water up and scatters it over the hill sides! You will not see a boat on this lake, and scarcely a sail. They do not dare to have them. Away yonder in the distance you can see Jönköping. Ten thousand people there, and scarce a pleasure boat in the town. It is sure death to be caught 100 yards from the shore when a squall comes down. Comes down, I say, that is comes over the mountains down on the water, and sometimes strikes it flat, sometimes the other way, and at all intermediate angles. I have seen the canvas on a small boat out on the coast at Gothenburg, pulled away and standing straight up in the air, here it is worse."

I tried to think what was worse, and resolved never to do any boating on Lake Wetter.

(To be Continued.)

MODERN BRAKES AND RAILWAY DISASTERS.

BY OTTO VON GELDERN, C. E.

In a recent letter from an old colleague, Mr. Hector von Bayer, who is a prominent civil engineer in Washington, D. C., my attention was called to a subject which, for a number of years past, has been closely followed by this gentleman.

He justly claims as one of the principal causes of railway accidents, the invention and introduction of the powerful brakes employed at this day, especially the air brake. While he emphasizes the great utility and the necessity of this meritorious device, by which a heavy train may be suddenly stopped, and which, no doubt, has *prevented* numerous accidents, he does not hesitate to state that there are also attending results of great evil, that either have never been fully realized, or are constantly overlooked and treated with intentional silence.

In checking the velocity of a rapidly moving train with this effectual contrivance, nearly all the energy of the tremendous load is taken up by the friction between the train and the track, and the result must necessarily involve the most dangerous strains upon the latter, and create a movement of the track, or rather a tendency to compress the rails in a longitudinal direction. It can readily be imagined what the effect must be upon the permanent way, for the rigidity of the rail is put to the severest test; particularly will this be the case in curves or badly constructed sections of track, for any fault or weak point is certain to give way under such strains. The general result is that the rails will be deflected, being either raised or depressed, or they will spread or close horizontally.

In the case of a bridge it will cause a movement of the structure in the direction of the train under check of the brake.

These are the main points that are brought out in the observations and studies made, and that they are based upon facts and data well founded, quite a number of cases will fully substantiate. I have extracted two, to convince the reader of the truth of the assertions of my friend.

In the horrible railway accident at Ashtabula, Ohio, on the 29th of December, 1876, a little after 7 P. M., during a severe snowstorm, the engineer failed to see the light that indicated the approaches to the bridge, (and where the railway station lay in close proximity) may be explained by the theory of energy imparted to the structure.

Constructed in iron, after the Howe system, it had a span of 120 feet. As soon as the train had reached the bridge under full speed, and the engineer became aware of his whereabouts and the closeness of his stopping station, he instantly put on his air brakes; these were pressed with full force against the wheels, and the bridge, abutting against the stone pier ahead, suddenly buckled up, and rising immediately in front of the locomotive, parted under the tremendous strains, and precipitated the train to the bottom, 86 feet below, and to destruction.

Mr. von Bayer relates an instance that came under his particular observation, which proves absolutely how dangerous these strains are, and what effect the air brakes can produce under conditions commonly arising.

Examining the draw-bridge over the Genessee River, at Charlotte, near Lake Ontario, he noticed that the station on the west side of the stream was located quite close to the end of the bridge, and that the trains approaching it from the east would frequently apply their brakes while crossing the stream in order to make a halt there. Shortly after the completion of this structure it was noticed that it began to jam against the stone wall of the western abutment, and that it could not be turned without first chiseling off the stone facing. This operation was repeated at regular intervals by stone masons whom he frequently observed at work on the western abutment, while the corresponding gap at the eastern end was just as frequently bridged over by lengthening the rails to compensate for the cut on the opposite side. In other words; the bridge traveled westward in the direction of the moving trains. Watching an approaching train and seeing the brakes applied while crossing the bridge at full speed, he observed that at the same moment the entire structure was forced towards the western abutment until it brought up against the wall there. It needed no further demonstration to point out a hidden danger, to which the attention of the public had never been called. The center or turning pier of this bridge, which proved to have a considerable leaning over to the westward, will have to be replaced sooner or later, for if the injudicious application of the air brake be continued another horrible disaster will surely be recorded in due time.

In a number of railway accidents the same theory will furnish a satisfactory explanation of the cause, where the most detailed examinations of experts have failed to throw any light on the subject. There is no doubt that this matter is worthy of the full consideration of those in authority, and the great traveling public in particular.

To avoid accidents of this nature all track constructions should be thoroughly overhauled to ascertain if they be sufficient to stand the test of suddenly applied modern brakes. Railway stations should not be located in immediate proximity to a bridge. A locomotive engineer should be cautious in the use of his brake when crossing bridges or running on curves.

We are dealing with an element that, like many others, is of the greatest benefit to us when properly manipulated, but may become a fearful enemy and destroyer if we fail to watch and control it intelligently.

ON WATER FRONTS.

In Bonnie Dundee, in Scotland, they do things better than in Oakland, Cal. Many years ago a "Provost" there, which means a mayor, and is a better term for that functionary, was instrumental in a wonderful improvement, and at the same time turned a penny for his sel'. The water front was a long, dreary waste of four miles or so, lined with wrack and worthless jetsom, dead fish, and other debris, much as the front of Oakland now is. As in Oakland, a railway wedged itself in between the people and the water front and essayed to build a stone wall, one of granite, along the water front.

The people for years assembled on Saturdays, and with a battering ram, proceeded, in an orderly way, to knock down the masonry at the ends of the street. On Monday morning the railway company proceeded to build up the wall again ready for the next Saturday onslaught of the citizens and the ram. Finally, like all things earthly, this came to an end with a court decision, that confirmed the rights of the citizens to keep their streets open to the water. Our Oakland friends do not attach the same importance to public rights, and seem to lack the vertebraical rigidity required to batter down a railway's wall, but this is not our story, at least not the main part of it.

The canny Provost, of Dundee, proposed to the citizens that he would build an "esplanade" on the water front, granite faced, paved, and complete, reaching out 650 feet, and present the whole a free gift, if the city would give him a goodly strip at the back on which to erect warehouses. This was done with alacrity, also with circumspection, because by some careful figuring it was found that the investment was first-class, as we would say. The Provost offered to repeat the matter and build more esplanade, but he was limited this time to twenty years' use of his strip at the back, and again made money.

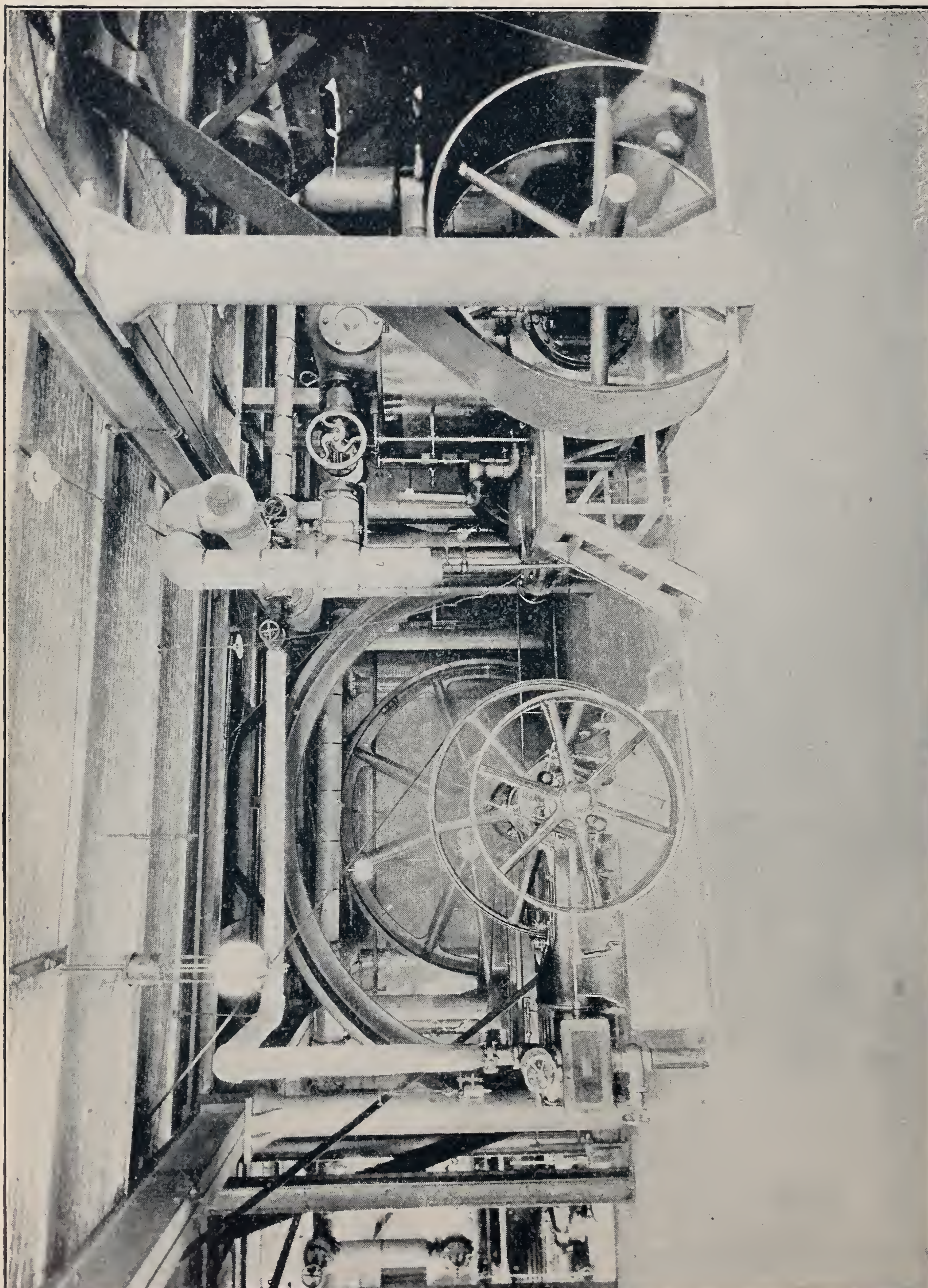
By this time the citizens concluded that the building of granite esplanades was a good business for them, and accordingly built and kept on building for "five miles" or so, and now have one of the finest embankments in the world, that returns a good share of the city's resources, and is, among all other things, Dundee's greatest pride.

This far is a story, suggested by reading, in a bright little paper of our neighbor city, a suggestion of how one might ascend the hills behind Oakland and see the city spread out like a picture, only much fairer than any picture, and then beyond see a dead coast line of mud and silence, where no one had any right to go, a wall, as it were, shutting out alike, streets, business, life and prosperity.

Farther back, a little more than two decades, we can imagine the people chuckling over their astuteness in forcing from the railway a right of riding free down to the water, in a lane. A wonderful concession, of which the public are informed by an ungrammatical proclamation that was formerly posted up in the railway cars. We have not dared for some years, to look at it for fear of corrupting the syntax of this Journal, and from a lost hope ot finding out its meaning.

Now the inference and deductions are as follows: The first care of a railway in entering a prosperous city or town is to cut off its water front, if it have one. This is obvious strategy. Nothing delights the heart of a railway man so much as a line around a water front.

There is little comfort in this for our friends of the Oak city. It is easy for even dull folk to point on what "might have been," and we have no pleasure in salting wounds for which we have no remedy, but there is a lesson to be learned for the future. There was, at the time of the Carpentier contract in Oakland, by which the city lost the greater part of its water front, plenty of able men who foresaw and understood the consequences to follow, but it so happened, as it happens now, there and elsewhere, such men do not administer municipal affairs. The best government is government by the best people, and until this is learned and practiced there is little safety for either public rights or public property.



A CASE OF COMPETITION.

The Westinghouse Machine Company, of Pittsburg, Pa., send us the engraving opposite, showing the power plant of the electric light company at Mount Morris, New York.

At the further end of the room can be seen a "Green" Corliss engine, 26″ × 48″, which represents the centralized or slow-speed system. In the central part of the room is a "Ball" high-speed, horizontal, double-acting engine, 12″ × 13″, while in the foreground is a Westinghouse compound, single-acting engine, 18″ × 30″ and 16″ stroke. The plant furnishes 11,000 incandescent, and 850 arc lights.

This is a kind of test case. The original intention was to employ three Corliss engines, but the comparative performance of the three types of engines has modified this plan, and as the Westinghouse Company claims, additions to the plant, now soon to be made, will include only high-speed engines, and most likely the single-acting type.

The question of centralized power by means of slow-speed engines with distributing gearing, compared to segregated engines directly connected to dynamos, is one of the most interesting problems connected with modern mechanical engineering; not that there is a debatable problem, covering all cases, but in respect to common cases, when either method is applicable.

The question divides itself into two heads of almost equal importance, one mechanical, the other economical, that have generally to be balanced one against the other. These two branches of the subject become entangled together. In the matter of attendance, for example, there is the problem whether that belongs to the mechanical or economical side.

One man can attend to 1,000 horse power represented in a single Corliss engine, but in the case of what we call high-speed engines of the double-acting class, 1,000 horse power is apt to require three or four men for the same duty. In the single-acting class attendance falls below even the Corliss engine, because the attendant has no particular function to perform, in fact there is nothing that can be done in the way of setting up, oiling, and so on. We have seen one man in charge of ten Westinghouse engines who pronounced it a "lonely kind of job."

The main point of difference in public estimation is steam economy, or fuel economy rather. This is apparent from the "log," but may be a very deceptive element when put with other factors on the slow-speed side of the problem and cast in with the aggregate of running expenses, distributed over a season. Just now, in this country, and as may be said from the first in other countries, directly geared engines have taken the lead, and we seem to be coming, all the time, nearer to what may be called a "steam dynamo," that is, when a generator will consist of a steam cylinder, piston, shaft, armature and fields, as one distinct machine. The term "steam dynamo" is not unusual now, and certainly applies to such types as the Willan and Robinson machines in England, and the Westinghouse in this country, where the steam portion is an adjunct to the generator rather than a separate machine.

As to ultimate economy of steam, in respect to types or classes of engines, considered in the abstract, there is little room for argument, but, as before intimated, when attendance, a variable amount of power, room occupied, maintenance, uniformity of speed, lubrication, and other conditions taken into account, and then all of these qualified by adaptation to particular cases, the complexity of the problem will appear, and in this, as a good many other things, we will have to fall back upon that inexorable law, the "survival of the fittest."

ON PILE DRIVING.

A pile-driving plant is not an attractive apparatus in appearance or otherwise. It seems a crude adaptation to necessity, and, of all things, without any economic problems connected with it, but this is a mistake, as will be presently pointed out.

In the early days of pile driving in North Europe, and in the Netherlands, where almost everything is built on piles, they were driven by hand, and are yet to some extent. The process is the same in so far as the ram, guides and general arrangement, but the hoisting rope, after passing some distance over the pulley at the top, branches out like a Russian knout, into as many parts as there are men to operate. The men take hold of these ropes, standing far enough apart not to interfere with each other, a song is commenced and the driving begins. The weight, which is usually a heavy one for such a method, is whipped up to correspond with the measure of the song, and comes down at exact intervals with a force equal to the aggregated power of ten to fifteen men, which is applied with a kind of swing and rythm that far exceeds their weight under a steady pull.

This movement is not easy to estimate or describe. There is at the start some rebound from the head of the pile, and some accumulation of force from a downward movement of the men's bodies, at any rate the operation goes on in a surprisingly effective manner, and at great speed, because the blows are all the time nicely graduated to the requirements, the same as a single man applies in driving a stake with a hammer.

This may seem a very crude process, but the piles are small, hardly ever exceeding eight inches in diameter. The mud is soft, and the number of piles so great that the supporting power of the areas driven will sustain the heaviest buildings, steam chimneys and other structures of masonry.

At Gothenburg, in Sweden, where this method of driving piles is employed in most cases, an English contractor, taking note of the matter, concluded it would be a good place to introduce his steam-driven plant, and, consequently, tendered for some work of the kind near the mouth of the Gotha River. To his amazement he was under bid by the hand drivers, and, on investigation, found good reason for the circumstances.

He tendered for "pile driving," and we commonly speak of the process under that term, but the driving part is very often a subordinate one, and frequently the least part of the process. To begin with, the pile must be selected, brought to the place, then hoisted and got into position for driving. These operations call for a number of men, and with small piles handling is much quicker done with men than with machinery. In driving, a steam engine may have an advantage, but as one of these Swedish contractors once said to the writer, "what are my men to do while the driving is going on; sit down and watch the machinery?" The fact is, hand driving is the cheapest there, also the most expeditious, and the traveler in these distant lands who writes home letters describing how the benighted country languishes for modern improvements is making a mistake.

GUNPOWDER PILE DRIVING.

It is many years ago, perhaps twenty-five, when Thomas Shaw, of Philadelphia, invented the gunpowder pile driver, and it was a wonderful invention, one of much ingenuity and boldness, that failed because of attendant causes, the same as the steam drivers failed in

Sweden. The Shaw gunpowder or explosive machine was the only really scientific one, in so far as the application of force, that has ever been invented for pile driving. The work was done by a "push," which avoided the inertia of the pile that consumes a great portion of concussive blows, such as are given by a falling weight.

On the top of the pile was set a kind of cannon, with a concave base resting on the wood. On the ram, or falling part, was a piston that fitted closely in the bore of this cannon resting on the pile. A cartridge not much larger than is used in a musket is dropped into the cannon, and the ram is dropped from some height above where it had lodged at a previous stroke. As the ram came down the piston entered the bore of the cannon and compressed the air entrapped therein, exploding the gunpowder by the heat due to the compressed air. The momentum of the descending ram was thus an initial force cushioned on the pile by the compressed air in the cannon, then followed with, or extended by the greater force of the recoil after the explosion, or the "kick," as Mr. Shaw called it. Instead of the weight falling on the pile, it was thrown upward, which is the same thing under the law of direct action and reaction.

The effect produced was astonishing. Piles were "pushed" into the hard earth at a rate that no one had ever seen before, or thought possible. Tables were prepared, showing the effect; consumption of powder, foot tons of pressure; diagrams of the force, and so on. The operation of driving was one of excitement that caused a wonderful impression on every one. A man stood on the platform near the cannon, at the top of the pile, and as the heavy ram was shot up between the guides, he quietly dropped a cartridge into the muzzle of the gun. There were grades of cartridges, so the blows or impulses could be varied at pleasure. No one had anything to do except the man who charged, and it seemed as though he were keeping the huge ram up in the air as an acrobat tosses a ball. The reports from the explosion of the pent-up gases were almost deafening when the charges were strong, and the whole was an exhibition that has, perhaps, never been excelled even in attempts to amaze people with pyrotechnic contrivance.

This far all was well. The piles could be driven against all kinds of "resistances" in a few minutes' time without the least injury to the heads, which did not need bands. But after the pile was down, and the flying ram was caught and held aloft, then came the query of "what to do next?" The economical phase was then reached. The cannon or cap had to be lifted from the driven pile, another one had to be raised and set in position, but the gunpowder apparatus had done its work and did not propose to engage in the menial pursuit of bringing and placing material. It was like a mason at the top of a wall, after he had laid the brick on hand, his part was finished until a new supply of bricks was furnished.

In the case of the pile driver when driving ceased, the disgraced and displaced donkey engine had to be called upon to raise and set the pile, first raising the now helpless driving ram to the top of the shears. When all was in place ready for driving, then the gunpowder man stepped forward, the ram was dropped, and pyrotechnics began.

The system, it was said, was defeated by a question asked by an Irishman who was watching the process, who asked: "Why don't ye raise the tup with the donkey and not waste the powder?" That question was not easy to answer. All the elements of a gravity driving apparatus had to be there just the same, even to hooks for raising the ram, and why should the engine, like the Swedish workmen at Gothenburg, sit down to watch the operation of driving?

These remarks are not intended as a disparagement of Mr. Shaw's invention. He is an engineer of high skill, who has developed a large number of useful inventions, and in this one gave to machine action a new application of forces which, so far as known, has never had mathematical treatment. The writer's opinion is that this recoil method, if at all applicable in the useful arts, is more nearly adapted to forging processes than any other. This impression is in part due to some experiments made before the Franklin Institute at Philadelphia, at the time of Mr. Shaw's invention—twenty-five years ago. A small machine, with a drop of six feet or so, was erected in the laboratory, or in connection therewith, and operated with gunpowder, or with a free fall as required. The comparative effect of the blows given by dropping, and by explosion, was easily discerned by the impressions made in a parallel bar of lead placed on an anvil beneath the ram. The degree of effect could be measured very accurately by the depth of depressions made in the lead bar by the two methods. The result cannot now be remembered further than that the reactive or gunpowder blows were much more intense, or so applied as to produce much the greatest effect.

STEAM PILE DRIVERS.

Condie, Nasmyth, and perhaps other makers of steam hammers, have tried direct steam-driving apparatus by which the expansive force of the steam was employed to both raise and force down the rams.

After what has been explained in connection with the gunpowder method, it will hardly be necessary to point out wherein a steam hammer, with its greater amount of detail, would fail for the same reasons. The "adjustments" are the main part, and the driving is really a subordinate one in most cases, and when the driving is difficult there is nothing to be gained by such increase of force as can be gained by direct steam hammering.

The common drop pile driver is indeed a remarkable case of double adaptation, where two separate and almost distinct functions are performed by the same mechanism without changes, and in a complete manner, especially when the tower and moorings are such as to permit picking up timbers at some distance from the place they are to be driven. The operation is also one wherein, if we consider the forces employed, the distances or range of movement, and the result, is one of the most expeditious known.

ELECTRICAL PILE DRIVING.

Mr. Van Depeole has recently given an illustration of how a pile-driving apparatus can be operated electrically, and has very ingeniously confined the proposed operation to driving "sheet" piling on a straight line, the main apparatus being mounted upon a railway. This has little to do with pile driving, in the general sense of that term, and the successful operation of a pile driver by solenoids is, we fear, a long way in the future.

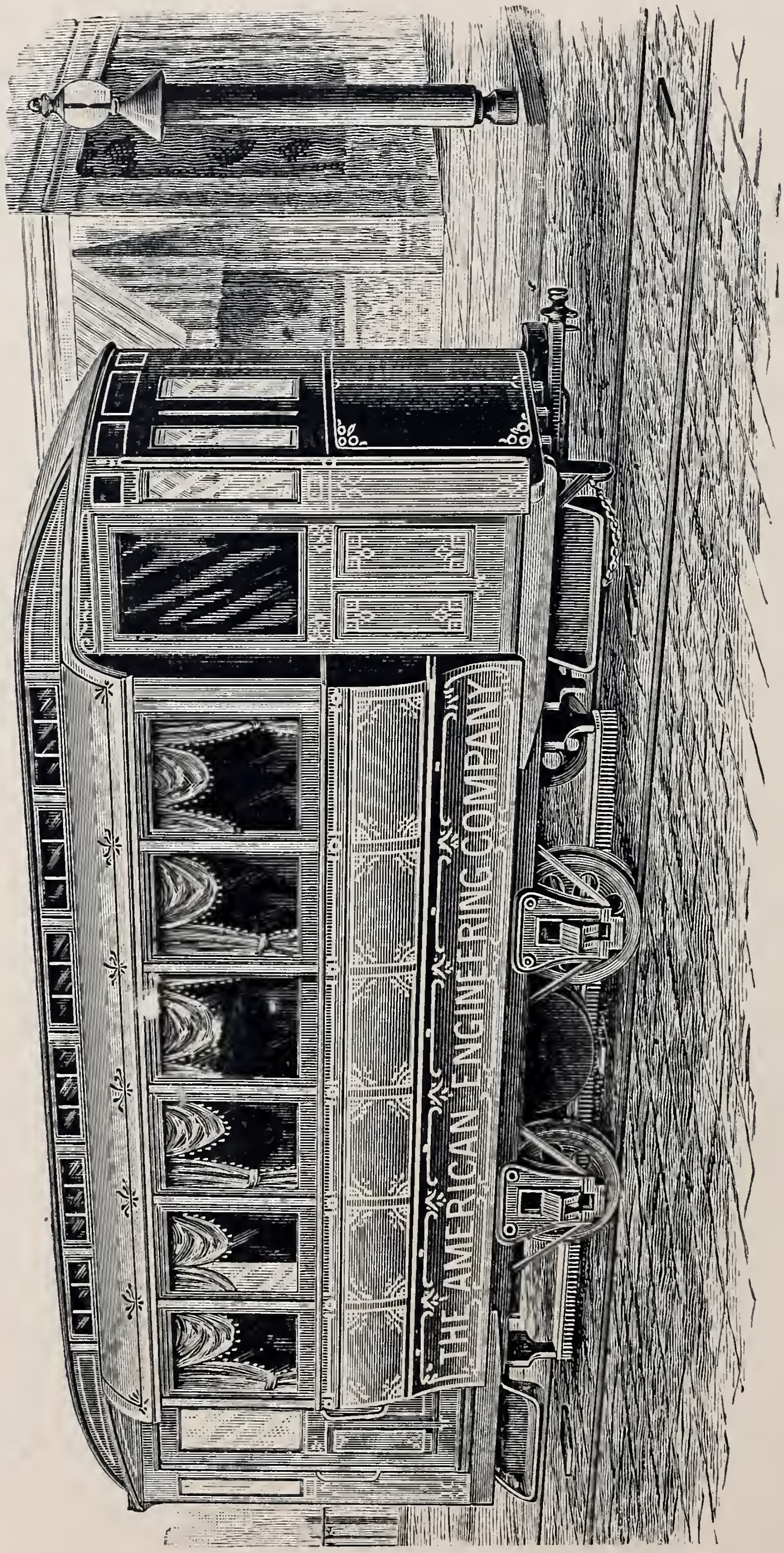
In the harbor of San Francisco pile driving has reached its maximum. The handling of "cargo engines" on the wharves has trained a class of men who are ready for pile driving, and the rapidity of the movements are wonderful.

MACHINE DESIGN.

Among the instructors engaged by the Leland Stanford, Jr., University, there is reported, a professor of "machine design." What this means we cannot say. Inferentially, we would call it the essence of mechanical engineering, or rather the quintessence of it, because if machine design can be taught in the abstract, there is little use of troubling with the rest. There must be some mistake in terms here, because the most able men, among them Professors Unwin, Reuleaux, and others, have not ventured further than to enunciate "principles" that will apply to machine design, but not rules of practice. Our idea of the matter is that long after a student has graduated in mechanical engineering, and mastered the curriculum of connected branches, and has been some years in the works, he may venture in a modified way upon "machine design." It would be a matter of interest to know what the standards are for even the simple elements of construction; a grindstone shaft for example. Some other term would better fit the thing meant, whatever it is.

The basis of machine design is not strains, or the nature of material in any sense that admits of teaching by rule, or as principles. It relates to the diversified conditions of application, and there are but two ways of learning this, that is, by precedent and experience, both of which give only a limited power of designing, and are far from constituting it a "profession." The ablest engineers in this or any other country, at the end of long experience, cannot claim more than a modified proficiency in preparing designs for machines, and anyone who can turn this art into a profession can command a salary of his own choosing.

Take, for example, the best existing books on the principles of machine design, and compare with practice here in San Francisco. Anyone who would design machines in accordance with the examples given, would be laughed at. We do not say that much useful data cannot be derived from such sources, bearing the same relation to the practical designing of machines that a table of roots or logarithms does to computation.



MULTIPLE DISTRIBUTING STATION SYSTEM.—AMERICAN ENGINEERING CO., NEW YORK.

A NEW ELECTRIC TRACTION SYSTEM.

There has been proposed, and to some extent applied, a new system of electric traction for street railway cars, called the "Multiple Distributing-Station System," promoted or represented by the American Engineering Company, of New York.

This system or method is the invention of Mr. G. T. Woods, of New York, to whom a patent was granted on the 10th of November, 1891, for an electric railway system. There are, as we believe, other patents, but the one named seems to be the base of the system as it has been applied at Brooklyn, New York, where a line has been laid down and operated in an experimental way. The main object of the system is to dispense with the overhead trolley wires, and thus obviate the most formidable objection to electric traction on urban lines.

The system of Mr. Woods is by no means easy to explain, or to understand, by those not skilled in electric matters, and the best way to attempt such explanation will be to quote from his patent specification, that portion which "declares" the invention and its nature, previous to technical description of the apparatus employed.

The specification reads as follows:

"The system, briefly stated, provides for placing the main feeder, which is insulated throughout, in a hermetically-sealed channel in the road-bed or carrying it parallel with the road, but not necessarily contiguous thereto, and locating in the road-bed, at intervals along the track, terminal heads, and then connecting each terminal head with the main feeder, and interposing in this working circuit from each terminal an electro-magnetically-controlled switch or cut-out, which is located at any point along the route, and in order to make the system more practical and efficient I group together all the electro-magnetic contact devices which connect with the corresponding terminal heads in a section or block of the road, so that when the road is in operation and any terminal head should appear to be out of order or damaged the head could be instantly located by examining the case which contains the magnetic device in connection therewith. By this system, therefore, the road-bed contains no operative mechanism of any kind whatever. Hence no derangement could possibly take place in the road, and as all operating mechanism for forming the working circuit through the motor is located by the side of the road—as, for instance, on the sides of buildings, or in cellars, or area-ways—the mechanism can be inspected and kept in repair, and, as in practice, only one case or group of these contact devices is placed in each block, the cost of inspection will be small, and in event of accident no test is required to locate the particular portion of the road where the difficulty lies. It should be stated that this system provides for placing these terminal heads preferably between the tracks of the railway, and that normally all the heads are out of the circuit and can be brought into the circuit only by the passage of a car having brushes of sufficient length to nearly span three adjacent terminal heads, and that the current when once established through two of the heads or terminals, will positively cut out the rear terminal by the electrical mechanism which throws in a new terminal, so that an absolute means is provided for making all the terminals, fore and aft of the car, 'dead,' and thus guarding against any liability of danger from 'live' terminals."

The representative here, Mr. T. M. Martin, furnishes the engraving on page 341, illustrating the appearance of a street railway car, and the permanent way, including the contact points and brushes, which can be seen beneath.

The American Engineering Company have constructed a line, or section of one, on Coney Island, or between there and Brooklyn, New York, where, it is claimed, very successful trials have been made under the inspection of city officers, engineers and electricians. It is also claimed there is no loss by leakage of the current, and protection from snow, mud and dirt is easy and complete. The voltage employed is so low as to offer no danger to attendants or others.

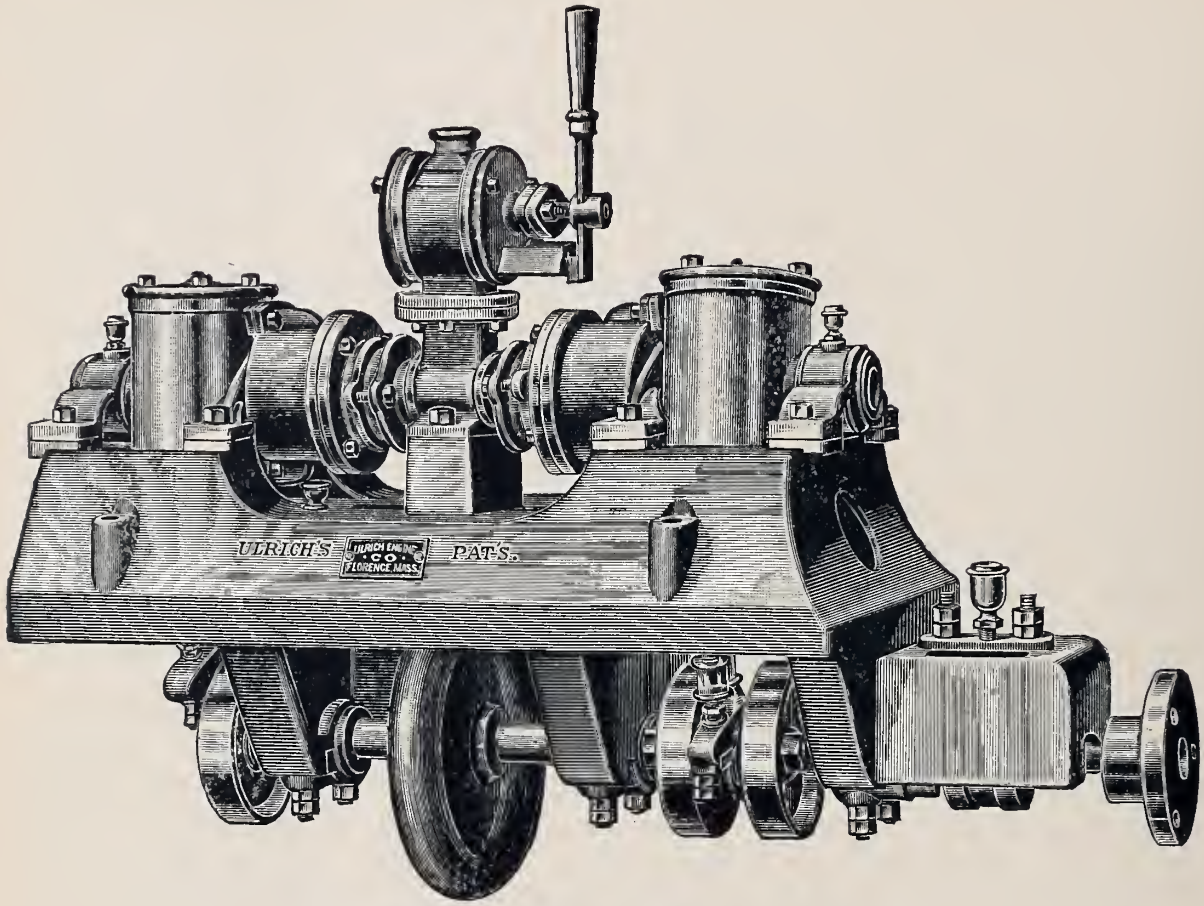
It is not extravagant prophesy to say that, at some time in the future, overhead, bare wires or the trolley system, as it is called, will have to be abandoned. At the same time it would be unreasonable, in many cases, to say that roads should not be constructed on that method. The Americans are just now doing in this matter, in an engineering way, what the French people did for civil liberty a hundred years ago. They are trying experiments for the benefit of the world, which elsewhere is waiting for the supersedence of the trolley system, and the valuable experience it has afforded in electric traction for urban railways. The development of electric traction involves various problems besides conduction of current, which is, indeed, but one of many, and the numerous American lines are, no doubt, the source from which must be drawn the main facts and precedents that will be developed into the complete art at some future time.

The system above described, if it have the features claimed, should engage attention everywhere. An illustration showing its application to lamps for street lighting has been left out of this issue for want of space.

CONICAL SHELL BEARINGS.

We have a good many times had occasion to comment on the vagaries of machine tool design, perhaps without effect, but must continue so long as tool makers will attempt to adjust conical fitted bearings endwise in their seats. Just at this time has appeared some drawings of an engine made by Messrs. E. P. Allis & Co., of Milwaukee, in which there is a shifting crank pin fitted into the crank disk by means of a conical bush which is split into eight parts, showing that the designer well knew that a taper fit does not admit of adjustment unless reduced to wedges. At the same time appears a new milling machine with parallel bearings on the main spindle, surrounded by conical bushes fitted into the main casting, to be "hauled through" for adjustment by means of ring nuts. Now, a fair inference is that the designer of the engine knew that there is no such thing as adjustment of a cylindrical taper fit, and employed it only for convenient fitting, also split the shell into eight parts so as to permit an infinitesimal adjustment, if that were required. Another inference is that the tool designer expected that by hauling a taper shell into a conical hole, he could, in some way, maintain a fit, and "compress" the shell upon the parallel bearings of the spindle. We do not mention names. It is not necessary, because these shell bearings tapered on their exterior with a view to adjustment, are common enough in this country, on machine tools. They can be seen most anywhere, and indicate good workmanship, because if bearings so fitted would wear enough to require compensation, the taper fit fallacy would be exposed at once.

Conical bearings are an old expedient for compensation, and one of the best when the taper made on the spindle is not so much as to cause a difference of wear at the two ends. Such bearings are employed on the finest machine tools, but a shell with a parallel bore, and tapered on its exterior, is bad practice anywhere, and leaves open an inference that the designer was ignorant of a very simple principle in construction.



OSCILLATING YACHT ENGINE.

Messrs. Rix & Birrell of this City, the agents here, send the above engraving of an unique yacht, or boat, engine, made at Florence, Mass. The engines have a number of features that adapt them for boat driving. The two cylinders can be operated separately, or as a compound engine. The total weight is a minimum, and the center of gravity lower than in any design we have before seen. The reversing function is performed by the valves, without links or external gearing, subject to wear or disarrangement. The elements are the fewest possible, consisting of a steam cylinder, piston rod and shaft, with a slide valve, it may be called, operated by the cylinder's oscillation.

The oscillating type of engines are commonly thought of as involving trunion steam joints, and coming, for that reason, under the head of radial bearings or faces such as exist in rotary engines, but this is not necessary in an oscillating engine properly designed. The finest types on "paddle boats" in England, including the omnibus boats on the Thames, at London, are of the oscillating kind, but provided with common slide valves, and are otherwise of the most durable description.

WOOD WORKING AT THE EXHIBITION.

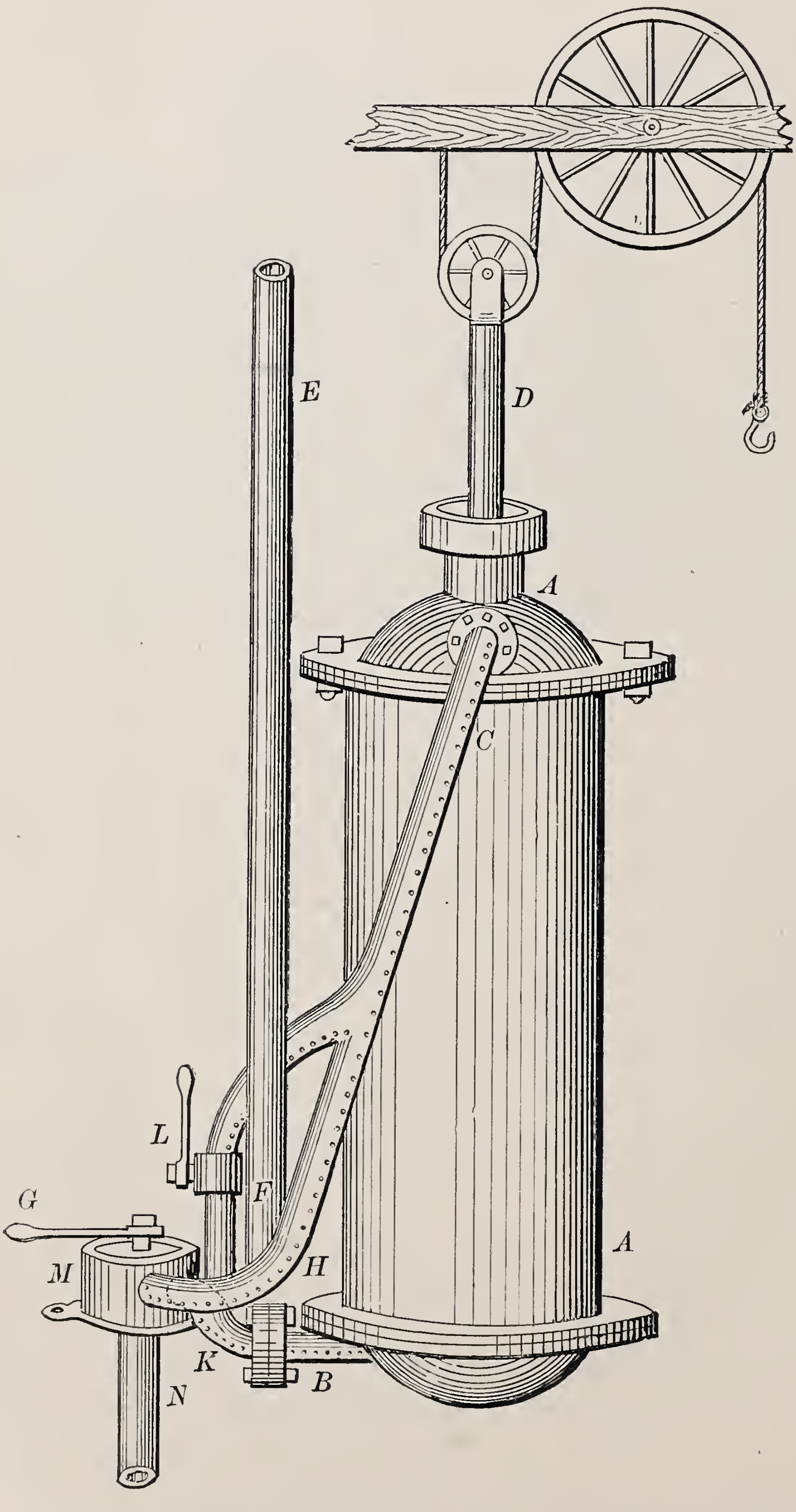
The display of wood-working machines at the World's Fair, in Chicago, will, no doubt, be very large. This is a department that will have much interest to foreign visitors, in so far as all processes in wood-working, except sawing and planing. In respect to the latter we have, on one or two occasions before, pointed out that the American method of planing boards, or "matched stuff," also mouldings, is not practiced in Europe, our machines working backward, so to speak, gauging from the rough side, thicknessing and facing on the same side. All other machines will be noteworthy, and with claims over European practice, unless it be in the case of copies of American machines, of which many are made in Europe, especially in Germany, but even these are apt to fall much behind the American originals. The Egan Company, of Cincinnati, inform us they have applied for 20,000 square feet of room in which to erect for display forty different machines.

A "GENERAL JOINER."

In a late issue of an English engineering journal there is an engraving of a "complete general joiner," which seems to mean that a number of wood-working machines are "joined" together, or mounted on one frame. There is a band-sawing machine hung upon one corner, a shaping machine on the corner of the band-saw table, a planing machine on a corner of the main frame, while a saw-bench occupies one side, or nearly a half.

Now the only apparent gain in this case is that of some iron in the supporting frame, while the loss in efficiency would easily provide good frames for each machine, and possibly a building large enough to hold them all.

There is one counter-shaft in common for the different machines, so that all of them must be stopped or started together, and the belt power, as indicated in the drawing, is hardly enough for any one of them taken separately. This general joiner, or combination machine idea is long in dying out in England. In this country we are well and finally rid of it for regular work, except that now and then some one from "wayback" exercises his ingenuity in combining machines, and contributes a new fund to the school of experience



STRODE'S HYDRAULIC ELEVATOR.—PATENTED 1802.

W IN PIPES FROM 3/8 in. TO 30 in. DIAMETER.

F...	IN INCHES.								
SL	8	9	10	11	12	15	18	24	30
1 in	156	212	279	356	446	793	1267	2652	4698
2 in	234	316	415	530	663	1174	1873	3909	6911
3 in	294	398	522	666	832	1473	2347	4891	8638
4 in	346	468	613	782	977	1727	2751	5727	10109
5 in	392	530	694	885	1105	1956	3110	6470	11415
6 in	434	586	767	979	1222	2159	3426	7145	12601
7 in	473	639	833	1066	1331	2349	3737	7769	13772
8 in	509	687	899	1147	1432	2527	4019	8351	14720
9 in	543	733	959	1223	1522	2694	4284	8900	15684
1 in	575	777	1016	1298	1617	2853	4536	9421	16599
2 in	840	1134	1482	1888	2355	4149	6653	13664	23993
3 in	1046	1411	1844	2348	2928	5157	8184	16958	29828
4 in	1222	1647	2152	2740	3416	5998	9539	19754	34732
5 in	1377	1856	2424	3082	3838	6769	10738	22228	39073
6 in	1518	2046	2665	3401	4239	7457	11826	24474	43011
7 in	1648	2221	2900	3691	4601	8091	12830	26545	46642
8 in	1765	2384	3113	3962	4938	8683	13766	28477	50029
9 in	1874	2538	3314	4217	5256	9240	14648	30296	53218
1 in	1992	2684	3504	4459	5557	9768	15484	32018	56238
2 in	2884	3871	5051	6425	8004	14059	22273	46016	80770
3 in	3557	4789	6246	7947	9899	17380	27524	56839	99731
4 in	4134	5568	7262	9234	11504	20192	31972	66005	115785
5 in	4647	6256	8161	10365	12923	22679	35903	74102	129971
6 in	5113	6881	8974	11411	14209	24932	39465	81442	142825
7 in	5540	7456	9724	12364	15391	27009	42641	88204	154668
8 in	5940	7993	10423	13252	16501	28946	45811	94508	165708
9 in	6315	8499	11081	14088	17540	30767	48690	100438	176090
0 in	6671	8975	11704	14880	18525	32492	51416	106052	185902

e Feet, divide by 7.5.

TABLE SHOWING THE ACTUAL AMOUNT, OR 80 PER CENT. OF THE THEORETICAL FLOW IN PIPES FROM ⅜ in. TO 30 in. DIAMETER.

FALL OR SLOPE.	INSIDE DIAMETER OF PIPES IN INCHES.																					
	⅜	½	¾	1	1¼	1½	1¾	2	2½	3	4	5	6	7	8	9	10	11	12	15	18	24	30
1 in 1000.	.05	.11	.32	.7	1.2	2.0	3.0	4.2	7.6	12.3	26	46	74	111	156	212	279	356	446	793	1267	2652	4698
2 in 1000.	.08	.17	.50	1.0	1.9	3.0	4.6	6.5	11.6	18.6	39	69	111	166	234	316	415	530	663	1174	1873	3909	6911
3 in 1000.	.10	.22	.64	1.3	2.4	3.9	5.8	8.2	14.7	23.6	49	88	140	209	294	398	522	666	832	1473	2347	4891	8638
4 in 1000.	.13	.27	.77	1.6	2.9	4.6	6.9	9.8	17.4	27.9	58	103	165	246	346	468	613	782	977	1727	2751	5727	10109
5 in 1000.	.14	.31	.88	1.8	3.3	5.4	7.9	11.1	19.8	31.7	66	117	187	278	392	530	694	885	1105	1956	3110	6470	11415
6 in 1000.	.16	.34	.98	2.0	3.6	5.9	8.7	12.4	22.0	35.2	73	130	208	308	434	586	767	979	1222	2159	3426	7145	12601
7 in 1000.	.18	.38	1.08	2.2	4.0	6.4	9.6	13.5	23.3	38.4	80	142	226	335	473	639	833	1066	1331	2349	3737	7769	13772
8 in 1000.	.19	.41	1.17	2.4	4.3	6.9	10.3	14.6	25.9	41.4	86	153	244	362	509	687	899	1147	1432	2527	4019	8351	14720
9 in 1000.	.21	.44	1.24	2.6	4.6	7.4	11.1	15.6	27.7	44.2	92	163	260	386	543	733	959	1223	1522	2694	4284	8900	15684
1 in 100..	.22	46	1.33	2.7	4.9	7.9	11.7	16.6	29.4	46.9	98	173	277	408	575	777	1016	1298	1617	2853	4536	9421	16599
2 in 100..	.33	.70	1.98	4.1	7.3	11.7	17.4	24.5	43.3	69.1	144	254	404	598	840	1134	1482	1888	2355	4149	6653	13664	23993
3 in 100..	.42	.88	2.50	5.2	9.2	14.7	21.8	30.7	54.3	86.3	179	317	504	749	1046	1411	1844	2348	2928	5157	8184	16958	29828
4 in 100..	.50	1.04	2.94	6.1	10.8	17.2	25.5	35.9	63.5	101.1	210	370	588	870	1222	1647	2152	2740	3416	5998	9539	19754	34732
5 in 100..	.56	1.18	3.33	6.9	12.2	19.5	28.9	40.6	71.7	114.1	237	418	663	981	1377	1856	2424	3082	3838	6769	10738	22228	39073
6 in 100.	.62	1.31	3.68	7.6	13.5	21.6	31.9	44.9	79.2	126.0	261	461	732	1082	1518	2046	2665	3401	4239	7457	11826	24474	43011
7 in 100..	.68	1.42	4.01	8.3	14.7	23.5	34.7	48.8	86.1	137.7	284	500	795	1175	1648	2221	2900	3691	4601	8091	12830	26545	46642
8 in 100..	.73	1.53	4.32	9.0	15.8	25.2	37.4	52.5	92.6	147.2	305	537	854	1262	1765	2384	3113	3962	4938	8683	13766	28477	50029
9 in 100..	.79	1.64	4.60	9.6	16.9	26.9	39.8	56.0	98.7	156.8	325	572	909	1343	1874	2538	3314	4217	5256	9240	14648	30296	53218
1 in 10...	.83	1.36	4.89	10.1	17.9	28.5	42.2	59.2	104.5	165.9	344	606	959	1421	1992	2684	3504	4459	5557	9768	15484	32018	56238
2 in 10...	1.22	2.54	7.13	14.8	26.1	41.5	61.3	86.0	151.5	239.9	498	876	1389	2051	2884	3871	5051	6425	8004	14059	22273	46016	80770
3 in 10...	1.52	3.17	8.89	18.4	32.4	51.5	76.2	106.6	188.4	298.2	617	1085	1720	2539	3557	4789	6246	7947	9899	17380	27524	56839	99731
4 in 10...	1.78	3.71	10.37	21.5	37.8	59.9	88.8	124.5	219.0	347.3	718	1262	2001	2953	4134	5568	7262	9234	11504	20192	31972	66005	115785
5 in 10...	2.01	4.18	11.69	24.2	42.6	67.7	99.9	140.1	246.4	390.7	808	1419	2248	3319	4647	6256	8161	10365	12923	22679	35903	74102	129971
6 in 10...	2.22	4.61	12.89	26.6	47.0	74.5	110.1	154.3	271.3	430.1	824	1561	2474	3651	5113	6881	8974	11411	14209	24932	39465	81442	142825
7 in 10...	2.41	5.01	14.00	29.0	51.0	80.9	119.4	167.4	294.2	466.4	964	1692	2682	3957	5540	7456	9724	12364	15391	27009	42641	88204	154668
8 in 10...	2.59	5.38	15.00	31.1	54.7	86.8	128.2	179.6	315.7	500.0	1033	1815	2876	4242	5940	7993	10423	13252	16501	28946	45811	94508	165708
9 in 10...	2.76	5.73	15.98	33.1	58.2	92.4	136.4	191.1	335.8	532.0	1099	1931	3058	4510	6315	8499	11081	14088	17540	30767	48690	100438	176090
10 in 10..	2.92	6.06	16.92	35.0	61.6	97.6	144.2	202.0	354.9	562.0	1162	2040	3230	4764	6671	8975	11704	14880	18525	32492	51416	106052	185902

The Quantities above are American Gallons per Minute. For Cubic Feet, divide by 7.5.

IMPROVED HYDRAULIC ELEVATOR.

Messrs. Cahill & Hall, of this City, makers of hydro-steam and hydraulic elevators, send us the drawing on the opposite page, and state that they are prepared to furnish hydraulic elevators in accordance with the plans shown, the chief feature of which is the circulation of the water from the top to the bottom of the hydraulic cylinder, on the downward movement of the cage.

The drawing herewith was made *ninety years ago*, by Mr. Thomas Strode, who was a blacksmith and consequently acquainted with all this kind of apparatus.

He says in his description of the machinery :

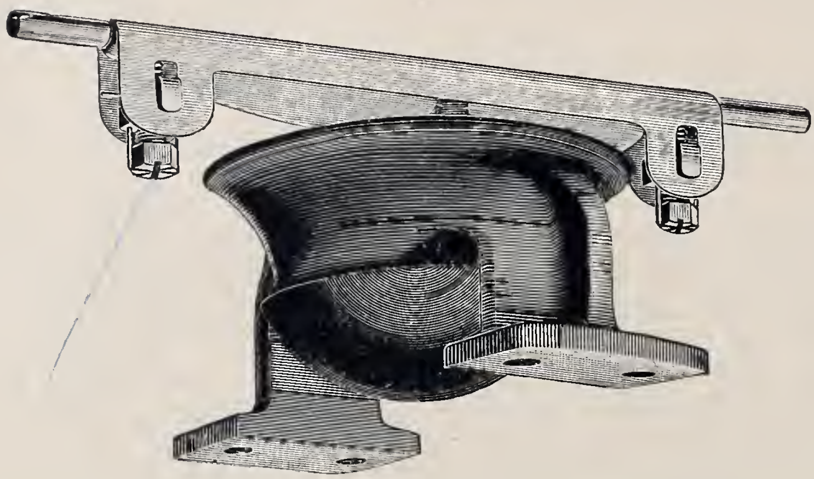
"A communication is to be made between the upper and lower "interior spaces of the cylinder, by means of a pipe, in which there "is a cock, and when this cock is gradually or partly opened, the "piston shall be at liberty to move by any reaction on the rod "thereof, as in lowering weights, with any degree of slowness or "speed which the attendant who governs the engine may think "proper."

Mr. Strode's design does not in various constructive features correspond to present practice. The pipes, for example, were of copper because those of wrought iron were not made in 1802.

The proportions too, are not well carried out, but Messrs. Cahill & Hall alter these as well as other parts of the machinery to suit the choice of purchasers, or to suit the circumstances of use ; they also guarantee those purchasing or using the machines against actions for infringing patents granted during late years on this invention.

There was about the beginning of this century, in England and various Continental countries of Europe, a surprising amount of research in mechanical matters. The wonderful discoveries of Bentham in wood working ; the band saw by Newberry ; various kinds of mills and water-raising machinery in the Netherlands ; the perfecting of Watt's engine ; oval and irregular carving and turning machines ; all date about the beginning of the century. The above described machine adds another.

These things came before their time, that is, before there was means for their dissemination, and must command admiration as inventions, because at the time there were few of the facilities for improvement and construction that exist now.



MINING INSULATOR AND CLAMPING BAR.

The drawing above shows a newly designed clamp bar and insulator by the Thomson, Van Depoele Company, which is thus described in their printed matter:

"The insulator body is of iron, thoroughly painted with graphite paint to withstand the action of the sulphuric acid in the mines, the insulator itself being made of pieces of porcelain rubber or other suitable material, strong and large to withstand severe strains. Its construction is such that the insulation is entirely protected from the blows of the trolley should it leave the wire, and, at the same time, little opportunity for grounding, because the head of the hanger bolt is embedded in the porcelain or rubber, and the single joint in the insulation is filled by a soft rubber washer firmly forced into position when the trolley wire ear is screwed into place.

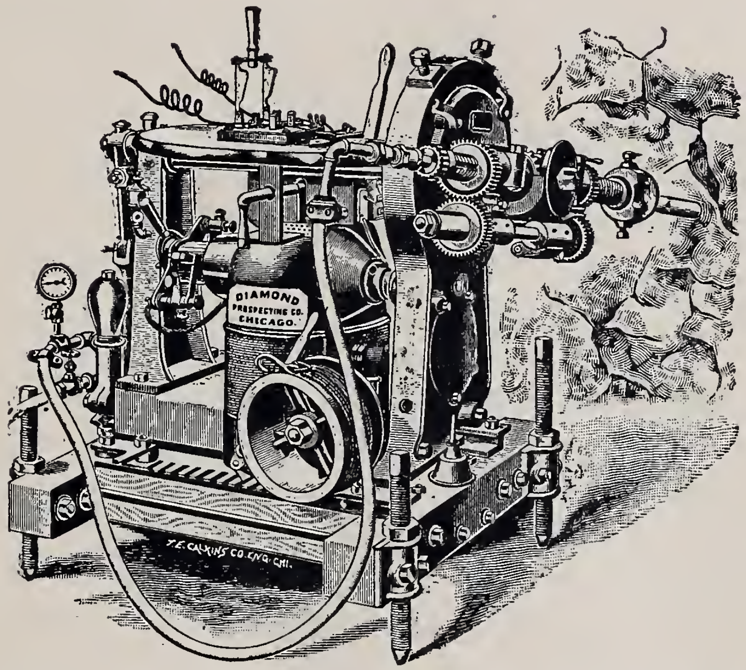
The only opportunity for surface leakage is on the under side of the insulator along the surface of the cone, and as this has been corrugated the liability of leakage is reduced to a minimum.

The clamping trolley ear is very easy to install as no soldering is necessary. Its security is greater than any soldered ear, because the wire cannot come down until the phosphor-bronze clamp, .032 inch thick and 8 inches long, is worn through.

The clamp can be loosened in a moment's time, and the slack in the wire can be taken up at little expense of time and trouble, a feature not possessed by the soldered ear.

Excessive sparking which occurs with other types of clamping ear is entirely obviated by making the bronze very thin, so it can be reduced to a knife edge at the end, where the trolley runs on. The clamping devices being situated at the end where the trolley runs on the phosphor bronze, the latter is sure to be pulled close against the wire at this point, securing a good fit and prevent sparking.

The clamping devices are positively locked by means of a stout German silver lock wire. It is not possible for the screw to back out without shearing off this wire. There is no corrosion, iron and steel have been entirely eliminated."



ELECTRIC DIAMOND DRILLING MACHINERY.

THE DIAMOND PROSPECTING CO., CHICAGO.

The Diamond Prospecting Company, of Chicago, have mounted their diamond drilling apparatus with an electric motor for driving, in the very neat form shown above. The adaptation, in so far as the elements of the plant, fall into place with surprising completeness, and there are many gains over the steam outfit hitherto employed, especially for underground working.

Impediments to diamond drilling have existed in the heat, noise and generally cumbersome nature of the apparatus, and in maintaining connections for steam or air, most of these objections are eliminated in the present arrangement with electric driving apparatus.

Mining operations have, more than any other department of power-using industry, adopted electrical apparatus, for the reason that the machinery employed is mostly of a portable kind, and to be operated in inconvenient places, sometimes in almost inaccessible places, where a simple wire for transmission has many advantages over pipes or hose, not to mention ropes or shafts.

NOTES AND COMMENTS.

The publishers of INDUSTRY, having had frequent calls for the table giving the flow of water in pipes, published two years ago, have decided to reprint the table, and have done so accordingly. The quantities for the larger pipes were derived originally from a table prepared by Mr. Günther, of Oldham, England, and for smaller pipes, down to one-inch diameter, by the Hawksley formulæ. For smaller pipes the flow is an average of several authorities, and, no doubt as nearly correct as in any published table that can be referred to. The chief value of the table is in its convenience, and the readiness with which the quantities can be ascertained. Each number of the present issue of the magazine contains one of these tables, in detached form, so as to be framed or mounted for future reference.

There is a considerable divergence of opinion among members of the Mechanics' Institute of this City, respecting the policy and conduct of its affairs, and the relevancy of these to its ostensible objects. One of the prominent people connected with the Institute remarked, at the time of the election, that without the shows conducted each year, there would be no revenue to meet running expenses. We would not figure it that way, but say, take from $750,000, the value of the books and fittings, and consider the rest of this sum a source of revenue. Five per cent. on $500,000 is $25,000 a year, and is $9,000 more than the estimated operating expenses of the Institute. The rent of room can be in part, or mainly, earned by the ground floor of a building in some central point, which the available means of the Institute would cover. It is claimed, and with a good deal of reason, that the management is "fossilized," and it does look that way, if the present influences and work of the Institute are considered. We will see what part is taken in the visit of the American Society of Mechanical Engineers to this City in May next, and will also note what our visitors have to say of so important an institution, bearing the name of their profession. It is not an easy matter to deal with the problems presented. No one questions the good faith and honest intentions of the management.

Mr. von Geldern's article in the present number on what may be called the "brake momentum" of railway trains, and its effect on bridges, will be read with interest, if not astonishment, by those who have not previously considered this matter. Mr. von Geldern would have furnished an analysis of the forces set up in braking trains, and the effect on bridge structures, but did not want to anticipate a discussion of the subject, which will be presented as a topical question at the next meeting of the Technical Society, April 1st. We suggest that the members should consider this problem and, as many as possible, attend and take part in the discussion.

A number of prominent men here in San Francisco, among them the executive officers of the Union Iron Works, have organized a company for the manufacture of material for ordnance, and have adopted the title of the Union Forge and Gun Company. For comment at this time, we will say that a consolidation with the Pacific Rolling Mills Company of any new enterprise of the kind, would, for many years to come at least, be a better thing for this City and the Coast, than an attempt to found a new works. The Rolling Mills Company have now a very extensive plant, recently remodeled, with additions and facilities nearly, if not quite, covering the requirements of ordnance manufacture, and another works of the same kind would mean a division of business that would render both enterprises unprofitable, in the line of large steel forgings and castings at least.

It is a fact, not nearly so well known as it ought to be, that mathematical instrument making is among the industries that have attained a prominent place on this Coast. This is a peculiar market to supply with almost anything. Woolen manufacturies were founded here, at first, with a view to supplying red flannel for miners' shirts, of better quality than the market afforded. The same rule applies to engineers' and surveyors' instruments. People come from all parts of the world, and there is what may be called a concensus of knowledge respecting such instruments ; there is also an extensive diversified and rough use of them. This has brought to this City a high order of skill in the manufacture, not only as to precision, but also in production. We some time ago examined the swivel, or stem mountings, also various other parts of a transit made here, and compared them with some of Eastern manufacture. The difference was wide, and altogether in favor of the San Francisco instrument. The most astonishing part was, however, that the price was the same, with the advantage of a local guarantee and gratuitous adjustment within reasonable bounds. We note, in this connection, an extension and incorporation of the works of Mr. Adolph Lietz, of this City, who has attained a well-earned eminence in his intricate art, and wonder if there is a want of patronage for an enterprise so commendable in every way.

The second section of Mr. von Geldern's essay on "Harbors of the Pacific Coast," was delayed in preparation by a press of professional business, and will be laid over until the next issue. This is regretted, but as the first article includes a separate division of the subject, the value of the articles is not impaired by the omission. The first division, or section, dealt mainly with the theories, or premises on which harbor works are constructed, and the physical conditions of this Coast. The second section will be devoted to works constructed, and in progress, given in terms that will permit a popular understanding of what is just now a matter of much interest.

The *Irrigation Age*, issued on February 1st, a sumptuous annual edition of nearly 100 pages, containing contributions from various well-known writers on the subject of irrigation, is profusely illustrated, and, on the whole, a great credit to the publishers. There are only a few people at this day that discern the enormous possibilities of irrigation, and it is only by wide generalization that the full force of the subject can be grasped. The dependence upon rains and the restriction thus placed on agriculture, is very like depending upon natural growth without breeding and cultivating. The time has come when the waters of the earth must be trained to their true purpose, and the problem is not beset by economic problems of any intricacy. Foremost in facts relating thereto, is the success of irrigated culture, reaching back beyond the time of the Pharaohs in Egypt, down to this very day here in California, and still more extensively elsewhere.

The offices and rooms of the Pacific Electrical Storage Company, in this City, are becoming, or have become, an electrical and scientific exhibition; one of much interest, and well worthy of inspection. A call there recently disclosed a "portable motor," mounted on a swivelling truck, driven from storage batteries, and capable of various new uses, especially in machine works. Power is transmitted by a flexible shaft, to drilling or other tools, the motor following about the same as an attendant. The Union Iron Works, in this City; the Cramp Shipbuilding Company, at Philadelphia; the Pennsylvania Railway Company; the Government shipyards at Washington, and other works are employing this unique power with most satisfactory results. The Pacific Storage Company propose various other applications of these "traveling motors." Another new thing to be seen is the method of starting the gas engine, employed to charge the example batteries in the wareroom. Instead of turning the gas engine by hand to start it, "the plant is reversed" The dynamo being converted to a motor, operated by the storage batteries, until the gas engine is started; then the current is reversed and the engine becomes the driver, returning the "lift" it has received, and sending the current back into the accumulators.

The public works, they may be called, being planned and erected by Adolph Sutro, in this City, are amazing in extent and character, and especially so when we consider that the enterprises of every kind are being carried on under his personal supervision, and built with his own money. Just now he is making plans for his library building at the Park, and has nearly decided upon one that will be unique, grand in size and aspect, as well as a complete adaptation, arising out of his technical knowledge of such matters. The main hall will be 100 × 200 feet, with shelf room 70 feet high. There will be ten tiers of shelving, with seven feet between galleries, so that all books can be reached from the floors. The outer gallery, next to the walls, will be 400 feet long, and the alcoves 20 feet deep; space enough to hold a million books. Besides this, there will be immense circular galleries at the ends, of 80 feet diameter, for serials and reading rooms. The great baths at Sutro Point will soon be covered with glass and metal. Some idea of their extent can be had from the fact that the roof would cover the Palace Hotel. Mr. Sutro is wise enough to build his own monuments in his vigorous life, and will earn a fame which future generations, better than the present one, will understand. His vast resources have fortunately fallen in fitting hands.

Congressman McKenna, who has recently been appointed a Federal Judge, with approbation from all parties, is to argue before the House Committee on Rivers and Harbors the cause of California's inland waterways, and considering the very moderate estimates made for improving the Sacramento, San Joaquin and Feather Rivers, there is every reason to expect a favorable action of Congress in this matter. Those who have no other way of estimating the effect that would be produced, can compare Stockton with other cities not having water connection with the Coast. The "slough" made Stockton, and maintains it. Few cities in California can not claim advantages over Stockton in the way of enviroment, climate and otherwise. Except as to fertile lands on all sides, as many others have, Stockton has had much to contend with, but not strangulation of her carrying trade.

It is common among those who think, talk, or write of a tariff on imports, or the enhancement of prices thus caused, to claim that the manufacturers are the only people benefitted; forgetting that although the prices of products may be more, the cost of producing is also more. It is of little advantage for a maker of engines, for example, to get an advance of 25 per cent. in price for his work if he has to pay 25 per cent. more for expenses, material, clothing, wages, amusements, books and the necessaries of life. As a matter of fact, the average profits of manufacturing are more, where prices are not disturbed by the impost method of raising revenue. Whether owing to a wider market, or other cause, we do not know, but the fact is undeniable. Those who rail at the profits of manufacture derived from a tariff, have looked but a little way into the subject.

The Royal Commission on Labor, in England, need not have been surprised at the testimony of a Leeds manufacturer of boots and shoes, who had the temerity to say that the art was thirty years in advance in this country, and that American made boots and shoes are sold in England at a good profit, and the trade was increasing. We commend to this commission the statistics collected three or four years ago by Mr. Schoenhoff, who was sent out as a special agent during the previous administration, to ascertain the comparative labor cost of various staples in Europe, and in this country. The reports to the State Department, at Washington, show that it costs a great deal more to make boots and shoes in England than it does here; also shows just how much more, which the witness above named did not. We cannot now recall the figures for Leicester, England, where prices were taken, but do remember that in Vienna, Austria, the price paid for making shoes was twice as much as in Lynn, Mass., and the "rate" of wages half as much, so that American workmen accomplish "four times" as much as the Austrians. The gain over England, as remembered, was about 50 per cent. The Americans have free hides to make their wares of, and this may have a good deal to do with the success of the shoe industry.

Captain McMahan, of the Engineer Corps, U. S. Army, has been lecturing the Philadelphia people on their water front and the want of facilities for handling freight. His remarks fit a good many other seabord cities in this country, most of them indeed. Formerly it cost more to haul machinery one mile in Philadelphia and put it on board a vessel, than it did to carry it across the Atlantic and land it at Liverpool or Antwerp. Captain McMahan also referred to canals, and pointed out their importance for inland carriage. He stated that canal boats could be sent from Dunkirk on the North Sea, to Marseilles on the Mediterranean, and thence to Bordeaux or Havre on the Atlantic, and that these canals are constructed to a uniform gauge, like railways. He claims "the last chapter on American canals will not be written for many a long day to come."

Senator Frye, who, some time ago, told us how it cost the schooner *Louisa A. Boardman* $60 in various fees and dues to clear from Calais, in Maine, for St. Stephens, in Canada, about three miles, and only $2.10 to come back again, proposes to better this state of affairs by a new and more extensive meddling with shipping affairs. We recommend him to read some of his own speeches before pressing his present bill, which proposes to examine, license, inspect, and generally control the engineering department of ocean steamers. Disbelieving, as we do, in the whole method and principle of such interference with private business, it will be useless to reprint the features of the bill. It is going the wrong way, and a long distance in that direction. Why not try this same method of inspection, licenses, examinations, and general "coddling" on the railway lines? They killed and wounded about 25,000 people last year, and on the score of public safety, need governmental attention a good deal more than ships do.

The Reading Railway Company has made another grand stroke in combining the anthracite carrying roads in one system, comprising about 3,000 miles of line. What it all means will appear in due time. We say another grand stroke, because about fifteen years ago the Reading Company undertook to control the anthracite trade of Philadelphia by the purchase of coal lands and distributing business, and succeeded, for a brief time, in doubling the price of coal. The final result was to put the Reading Company into the hands of a receiver. It is a corporation not given to philanthrophy, and has a very crooked record, as the investigations of the Congressional Committee of 1888 will show. By the way, this report is not very common, and we have never seen a "bound" copy. One was procured from General Rosencrans, a "stitched" one, and was waited for a long time.

Mr. T. V. Powderly, chief officer of the Knights of Labor, says that "Congress should issue a full legal tender paper dollar, based upon the only thing that can make money really valuable—the faith and resources of this go-ahead nation." Faith and resources will not do for a paper dollar, or any other dollar, as Mr. Powderly would soon discover, if the note, or thing, was not convertible into other values. A dollar not convertible into gold, silver, iron, copper, clothing or food, is not money, and the endorsement of the universe will not make such a paper dollar worth one per cent. If Mr. Powderly had a check drawn by Mr. Vanderbilt, he would call it good, just so long as Mr. Vanderbilt would receive the check and substitute it with whatever it called for. Unless this was the case, the check would be no better than a "Continental Shin-plaster." Values must be real, not representative, unless convertible, and when convertible they are in a sense real.

The *Mechanical News* has, in a late issue, a portrait and a biographical sketch of Seth Boyden, mentioning various of his important inventions, but not what we think the principal event in his engineering career, the introduction of the Fourneyron turbine wheel at Lowell, Mass. If we mistake not, this was the greatest of his works, and these wheels the first turbines of a high class constructed in this country. Mr. W. B. Bement, senior, founder of the great firm in Philadelphia, worked, when a young man, as a draughtsman under Boyden in designing these wheels, and often attested to the precision of the work, instancing the dimensions given for the "radius of all fillets." A mechanic of our acquaintance, who worked on the wheels, has told us how the vanes, made of sheet steel and inserted, were all planished and sharpened like a knife, on the edges of entrance. We think the *News* should amend its notice with some account of Mr. Boyden's turbine practice, if he was, as we suppose, the introducer of the wheels at Lowell.

A writer in the *Scottish Review* claims that accidents in the North Atlantic service have diminished as the speed of the ships has been increased. It is, of course, a question of facts, but it by no means follows that one is a cause and the other a sequence; that is, that the speed gives greater safety, except—and it is an exception of some importance—that the danger of a vessel is as the time she is exposed at sea. The cause of greater safety we imagine to be a better class of vessels, and the evolution of skill in their management. Some years ago it was an open question whether it was safer to "slow down" in the fogs, which in certain seasons are encountered on the Banks of Newfoundland, and whether it was not better to drive on and run through the fog as quickly as possible. One commander we heard discussing the matter, said: "If we strike anything, it don't matter much whether we are at half speed or full speed, and our chances of being struck are just one half as much at full speed." Be it as it may, the fact is that accidents have run down as the speed has run up.

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In a letter written to the *Engineer*, London, a maker of disintegrating or attrition machines for pulverizing hard material, claims that his firm makes machines that will grind solids containing 25 per cent of silica, so as to pass through 80 to 100 mesh screens, at three shillings per ton, or using 336 pounds of coal for fuel to every ton of material treated. It is barely possible that this impact or attrition method of pulverizing may be cheapened so as to compare with other processes for fine pulverizing, but experience in this country points the other way, for minerals at least. These machines have been experimentally developed. No one knows just what takes place inside of one, so there is little theoretical aid in the matter. The material is knocked and buffeted about by high speed beaters, and is, supposedly, ground away by attrition.

Stone says that the best iron bridges do not last more than forty years, and that the Pennsylvania Railway has discontinued iron bridges, ordering that only brick and stone shall be employed in future. This is so much at variance with popular opinion as to be noteworthy. Certainly iron structures, preserved by paint, especially those of cast iron, have a longer life than forty years, but any material subject to rapid corrosion cannot last like one not subject to such deterioration. There have been a great many accidents with iron bridges, and if the assumption above is correct, we have not yet reached a culmination of such accidents. A wrought iron bridge, with a narrow factor of safety, is certainly not a structure that commends itself, except for cheapness.

In our last issue we complained that lathe makers did not put three pairs of wheels on the back gearing, and extend the support of the poppet spindle beyond the sliding head in front. We notice since then that Prentice Bros., of Worcester, Mass., are gearing their lathes as suggested, also have a small projection of the shell of the poppet spindle. If they will now gear the cone pulleys to the lead screws of their lathes by means of a sliding pinion, we will further advertise them free of charge. If they will further eschew all kinds of rattle-trap clutches on the overhead shafts, and supply pulleys of large diameter with a narrow face that will have the same function as clutches, and the additional merit of lasting for a life time, they will find people to buy such lathes.

Mr. Robert McGlassen, writing to *Industries*, London, says: "No part of a propellor wheel can possibly give any propulsive effect, which has not a circumferential velocity greater than the longitudinal velocity of the ship through the water." This may be called an axiom. It is self evident. But what are we to do when the angular velocity is converted to longitudinal? That will take another section of the propellor away as useless, and dispose of all that lies within a circle where the resultant of angular velocity exceeds that of the ship's movement. This means that there is a neutral core of retardence, which Mr. McGlassen fixes at eight feet in diameter for the steamer *Teutonic*, that runs at 20 knots an hour. The proposition seems to be true, and, if not, "why not?" Perhaps some of our readers will explain.

In the *Iron Age* of February 25th, is illustrated a machine for compressing copper bands into grooves around projectiles, which reminds us of seeing, some years ago, a machine of a similar kind for compressing cold, the iron bands on the naves of artillery wheels. The machine was to be taken to the Tartar Frontier, in Russia, where the extreme dryness in Summer caused the wheel bands to fall off. The apparatus worked with toggles or cams, we do not remember which, but the whole affair was light enough to haul on an army wagon, and about one fourth the size of the one above named, for copper bands. The design was suggested by Major-General Altvater, of the Royal Arsenal at St. Petersburg, who was originally an artillery officer.

The old West "swashplate" or disc engine has been revived in a new and perhaps improved form, and occupies a prominent place in a number of our exchanges. The Tower spherical engine in England, is another type of the same class, and there are others. The "West" engine, which came out in London, and was also made in Hartford, Conn., in this Country, about twelve years ago, all things considered, was the best one produced. The "swashplate" in this engine was not a piston or steam tight. It was an element of the crank, or a lever against which a number of cylindrical, single-acting pistons pressed. The last one, above referred to, called the American high-speed engine, has the vice of roller bearings, and other features that indicate fortitude on the part of its makers.

In a recent letter received from Mr. John Walker, general manager of the Walker Manufacturing Co., Cleveland, Ohio, he says that the books of the company show $230,000 of unfilled orders. These orders include 36 of Walker's patent differential drums for cable railways, and that 130 of these have already been furnished. The Broadway cable road, at New York, is to be supplied with drums 32 feet diameter, faces 8 feet 4 inches wide, weighing 115 tons each. There are also to be made for this line several friction clutches to transmit 1,200 horse power. It is only eight years since this company was founded, and its phenomenal growth is the result of "methods," or, in other words, engineering skill. We visited the old foundry in 1886, and were amazed to find the floor undermined with arched vaults, containing "machinery for moulding." There were employed methods that in the end forced other works throughout the country to send to the Walker Company for large gear wheels and pulleys that could not be made economically and perfectly in common foundries.

There are few achievements in modern engineering practice that are more remarkable than the duty attained by direct-acting pumping engines. It is true the increased economy of steam engines is great in all departments, but in pumping it was generally thought and conceded that no great gain could be made over the old Cornish standard of 70,000,000 foot pounds of water raised for 100 pounds of coal. The American Society of Mechanical Engineers, some time ago, adopted a standard of 1,000,000 heat units instead of 100 pounds of coal, which is certainly a more tangible quantity, and one that provides for various grades of fuel. Under this code a recent test of a Worthington direct compound expansive engine, at Lowell, Mass., gave a duty of 115,000,000 foot pounds for each 1,000,000 heat units, and performed at the rate of 541,250 gallons per hour, with a pair of pumps 27½ inches diameter. The duty attained by these Worthington direct-acting pumps is an anomala of our time; a thing that no one, ten years ago, would have thought possible.

It will be a comfort to the industrial world when we can settle down to some kind of uniformity in steam boilers. During forty years past there has been no disturbing factor pertaining to use, except increment of pressure, demanded by the highly expansive engines, and this need not in a great degree modify construction except as to heavier sections. As Mr. Carlyle says, "every cranny and dog hole" has been searched, argued, disputed, and discussed over, until one would expect, out of all, some kind of agreement as to "type," but, this far, learned commissions and societies have avoided even recommendation of any rules looking to uniform practice. It is quite time this was commenced. There will be a fierce onslaught on anything set up as a standard, because of the innumerable hobbies and "vested rights" of makers, but the people, who, without personal knowledge to guide them, have to buy boilers, will rise up and bless such a movement. Steam engines have nearly settled down to a routine of construction, but boilers seem to be going all the time further away from such a consummation.

Indications are that the beam engine will have to succumb to screw engines in the Sound and river service at New York. This is no fault of the beam engine, nor a proof of the arguments that have been urged against the type for inland service. It is a result of modern advances in steam engineering, which the beam engine, as a class, could not follow, we mean in high pressures, low expansion and high rotative speed. At least, two first-class Sound steamers are now being built for screw engines, and there are three ferry boats with screws, plying successfully at New York. The fact is not, however, to be viewed so much as an abandonment of beam engines as it is the abandonment of paddle wheels. Hereafter these will be confined to shallow water, which is an avoidable impediment in so far as most tidal waters, but not for rivers. The double screws, when compared with a single one, have lessened draught a good deal, and there seems to be a concurrence of circumstances against our old friend, the beam engine.

No less than eight of our exchanges came this month with an engraving of a journal box invented in Philadelphia, in which the cap is clamped between the two lugs and held by friction, instead of screwed down in the common manner. There is an illustration of a saw mandrel constructed in this way, and it is one of the clumsiest designs imaginable. Designs aside, we would like to see the inventor try such a journal box on the spindle of a rough blocking saw, and see if the spindle did not "come out" when a sliver went in alongside the saw. The height of the box, which, even in the common form, is an impediment, is in this case twice as high, above the spindle. The idea is an old one. Bearings of the kind where the caps slid down on the spindle and were clamped by screws, had a kind of "run" about twenty years ago, and went out again by "natural selection." If it is not desirable to have a half box adjusted by direct screws, there are a good many other kinds of bearings that we think are preferable to the one referred to.

In several of our exchanges appear notices of, and in one case a drawing, of a French diamond stone-sawing machine, operating with a circular saw, or disc, having carbon points set around the periphery. American inventors, about twenty years ago, went through the power stone-dressing matter, including saws precisely like the one above mentioned. Those who visited the Centennial in 1876, will remember that a very good example of these machines was shown there in operation. A little earlier, very expensive machines were made in Philadelphia to "surface" stones with diamond tools or points, and about the same time stone "shaping" was attempted by means of small diamond cutters, or "heads," guided by patterns. The whole scheme has passed out, unless we except the diamond drill, which survives because of the peculiar nature of its functions, and regularity of the strain upon the carbon points. The fact is that the diamond as a cutting implement for dividing and shaping material has been a failure commercially, not, perhaps, so much because of its cutting or abrading properties as the impossibility of holding and presenting for rough work.

The "Steam Turbine," as it is called, of which drawings and a description were published in this Journal in 1888, has since then held its place, and if reports of its recent efficiency are correct, it is quite time the system be seriously considered. The eminence of the first inventor, Hon. C. A. Parsons, member Institute Civil Engineers of London, and his high professional standing, from the first caused people to expect some sound issue of the matter in the end, and this seems to have arrived. When a turbine wheel will develop a horse power with 27 pounds of water, or as the latest report is, with 21 pounds of water per horse power per hour, and with "5 pounds of engine," and when the speed has been reduced, as in the case of the Parsons engine, to 4,800 revolutions per minute, we may safely say the piston engine has been excelled. There is, however, one impediment, which we pointed out last month, the fitting requires an exactness not attainable in ordinary shops. The turbine principle, which is essential to the expansive action of the steam, involves "running fits" close enough to prevent serious leaks. The Dow engine fitted up by Messrs. Warner & Swasey, of Cleveland, Ohio, is, in some respects, a better designed one than the Parsons.

The connection of electric motors to the driving wheels of railway cars by cranks and links to preserve the motors from the jar and vibration of the axles and wheels, does not seem a very great invention, but it is an important one. The same thing is seen in all steam locomotives, the engine being so connected to the wheels that the engine itself will not partake of the jar and vertical movements of the driving wheels. The transition from a steam engine to an electric motor does not require a very strong effort in the way of invention. It is scarcely a case of "double use," but, as before said, is common sense and useful. It is called the "Field & Eichemeyer system," and will no doubt "prevail."

The part that electricity is to have in the reduction of minerals permits of wide conjecture, also of innumerable "fakes," like the sugar process of some years ago. The last announcement of the kind relates to the reduction of iron ores, and the claim is made that the process costs one fifth as much as the common blast furnace one. Considering that the metal must be melted, this seems preposterous, and the end will be, no doubt, something very different, if there be a discovery at all. It is a German invention, and from its absurdity will, no doubt, find support for a time. Whatever is invisible is mysterious, and whatever is mysterious is popular, but when such results as are attained in the electrical reduction of aluminium, it is no wonder that attention is turned to other metals.

The triple expansion engines made by the Dickinson Manufacturing Company, of Scranton, Pa., for the Edison Electric Company, to be used in New York, are as nearly marine engines as that type can be applied on land. The cylinders are 18, 27 and 40 inches diameter, 30 inches stroke, and the capacity at 130 revolutions is 600 to 800 horse power. These engines are provided with the Joy valve gearing, designed by the inventor for the engines. The armatures are mounted directly on the engine shaft, and the whole is the largest electrical "machine," ever made in this country. *Power* illustrates these engines in a fine manner, and in the same number mentions the construction of an engine for stationary purposes at Philadelphia that is to develop 12,000 horse power, the largest ever made in this country. There are three cylinders, 50 inches diameter. The engine was designed by Mr. E. D. Leavitt, of Boston, and is no doubt for the Calumet, or other of the Lake Superior Copper Mines.

There is probability that Mr. Nickola Telsa, who is one of the ablest electricians of our day, will, in the end, provide an alternating motor having in full the functions attained by the constant current type. It is four years ago when the Westinghouse Company considered or came near engaging in the manufacture of alternating motors under Mr. Telsa's plans, and now that the subject has come up again or been followed all this time, the tentative work is no doubt complete. The Westinghouse Company do not often make mistakes in estimating new things. Mr. Telsa, in a recent lecture in London, illustrated various interesting phenomena with currents of 25,000 alternations, or reversals per second. This is 150 times the rate of a common alternating dynamo. This discharge he took through his hands, and claimed high frequency of alternations gave immunity from shocks in such cases.

A goodly share of what may be called electrical literature is devoted to new applications, and of these three fourths are scarcely worth mention at this day, because motive power, in the abstract, is an element capable of use for all common purposes. In other cases, however, where there is a special adaptation of electric transmission for power, the subject is one of much interest. For example, a company at Springfield, Ill., composed of reliable people, propose to build an electric railway 250 miles long, in a straight line, and will attempt to drive trains by means of electric motors, at 100 miles an hour. There is nothing improbable in this, in fact a straight line road, without impeding grades, could be operated at that speed by steam locomotives especially designed for the work, and hauling light trains. We are usually cautious in announcing any of these schemes until some real work is done, but, in this case, the report comes through a very reliable source.

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The Idaho Mine, at Grass Valley, Nevada County, Cal., owned principally by Messrs. Edward and John Coleman, has produced in net profit eight millions of dollars. A recent statement places the whole yield of quartz mines in Grass Valley at $100,000,000. The Idaho Mine is one mile from the town of Grass Valley, on Wolf Creek, into which the slimes are dumped. It is a model mine in all of its appointments, and a typical one, which would be very suitable for the Mechanical Engineers to visit in May, during their visit here on this Coast.

The latest grand mining camp to the North, is the Kalso Slocan district on Lake Kootenai, in British Columbia. Railway lines have been built to the district, and the reports are such that all comparisons are with reference to the "Continent." There are hundreds of mines, and Slocan City, the focal center, is growing up, as Virginia did, only faster. The effect of discovering rich mineral lodes at this time will be fortunate for the country there. Whatever is gained in population is likely to remain, even if mining fails. A mining population, that is the working part of it, is at this day an especially energetic and intelligent one.

The vagaries of invention are typified by a stone-crushing machine, recently illustrated, in which the reduction of motion, or the intensification of force, is produced by two hydraulic pistons of different diameters. The crank shaft is elevated five or six feet to get in a pump, and has an overhung crank on one end. The details of the machine are about doubled in order to introduce the "hydraulic idea." The men who attend stone crushing machines, are not, as a rule, very well acquainted with hydraulic apparatus, and will be a little puzzled over glands and cup leathers. These pumps, if they do not freeze up, will keep scoured with sand. The case is one that should be considered by a professor of machine design, who might, perhaps, find out what the hydraulic part is for. We give it up.

The Hale & Norcross Company have now a new board of directors, under control of Mr. Flood, as chief stockholder, and the incidents of the election which took place on the ninth of last month, differed in a good many features from the routine common in such cases, and as the *Mining and Scientific Press* says: "the indications are that it is the dawn of a new era for the Comstock." It is, however, only indication, thus far, but strong indication of decrease in robbery, such as evidence in the Tingman suits go to show. There is in nearly all corporate bodies a disposition to ignore the shareholder, and provide for separate interests on the part of officers. The independent freight lines on Eastern roads was one of the first extensive movements of the kind. There were lines and lines—red, white and blue, in which the officers of railways, were shareholders on "personal account."

The following, on "Nickel and Nickel Mines," from the *Engineering and Mining Journal*, will have especial interest at this time:

"The remarkable development of the nickel mining industry in Canada is one of the marvels in the recent history of mining. In 1889 there was but one company producing in the Sudbury district, and in the following year the output exceeded 1,000,000 pounds of nickel, surpassing the output of the famous mines of New Caledonia. With these two deposits of nickel, both of which are of vast extent and contain ore of high grade, there is evidently no danger that the demand for nickel will outstrip the supply, although consumption of the metal is increasing enormously. During the past year this has been particularly marked, a large amount of nickel having been purchased for the manufacture of nickel-steel, both in the United States and in Europe.

At the same time the demand for nickel from other channels of consumption, such as nickel-plating and the manufacture of German silver and various alloys, has undergone considerable expansion, and bids fair to increase still further, as several new alloys, of which nickel is an important constituent, and which promise to be of considerable use in the arts, have been invented during the past year. This and the fact that the United States Government has definitely decided upon the adoption of nickel-steel for the armor of the new cruisers and battle-ships, insures a very large consumption of the metal next year. In view of this, the *Societe du Nickel*, and the Canadian companies have all been increasing their smelting plants, and the supply of ore being very large, the supply of the metal is limited by the capacity of these works only.

The United States, which formerly led the world in the production of nickel, has dropped to third place since the opening of the Canadian and New Caledonian fields, and for several years its product has been steadily diminishing, owing to the exhaustion of the famous old Lancaster Gap mine. This has been the only important producer of nickel in this country, and although deposits of the ore, which have been considered promising, have been discovered in several places, nothing has come of them so far. Oregon and Nevada are perhaps the most promising localities, nickel silicate ore having been discovered at Riddles in the former State, and nickel-cobalt sulphide in Churchill County in the latter. Nothing of consequence has been done at the Oregon mines during the past two years, and those of Nevada were also long idle. Last spring, however, one of them was purchased by an Anglo-American company, which has done some development work since then; a considerable quantity of ore has already been taken out, we are informed, which it is thought will assay well, but none has been shipped yet. The results of this enterprise will be watched with interest. It seems very doubtful, however, from the present outlook, whether the Oregon or Nevada mines will ever replace the Lancaster Gap. The only other producers of nickel in the United States are the Mine La Motte and St. Joseph Lead Company."

LITERATURE.

Irrigation Canals and Irrigation Works.

BY P. J. FLYNN, C. E.

The author of this work has sent a copy for review, and thereby has imposed a task as extensive as it is difficult and agreeable. It requires some temerity on the part of almost anyone to write opinions of a work of this extent, relating to a branch of engineering work which is here, almost for the first time, treated in the abstract and in a comprehensive manner; and still more temerity to publish views respecting an art or industry that is soon to have a foremost place in the material interests of our country and people, and will command the highest attention on the part of skillful engineers all over the world.

In dealing with a new book there are certain features taken progressively, beginning with, who the author is, the binding, paper, typography, margins and general dress. Next we look for contents, the divisions of the subject, and then run over all to see the amount of work bestowed upon the book by the author. Then we proceed to examine such sections as have special relevancy to the wants of the time, and can be compared with other authorities on the same subject.

Proceeding in this manner we will say that Mr. Flynn was a graduate of Addiscombe College, near London, England, and in competitive examination received a government appointment as an apprentice engineer of the first class, and was sent to the celebrated Roorkee College of Civil Engineering in India. From there he was appointed to the Public Works Department in India as an Assistant Engineer, and had there ten years of service as an assistant and five years as an executive engineer on the public works of the Punjab.

The Roorkee College in India gives special training in irrigation works. It is situated near the principal works on the greatest of irrigation canals, the Ganges. The early training of the author, as will be seen, was of the best that the world afforded.

In 1873 Mr. Flynn came to California to pursue his profession here, which has been onfined mainly to works involving hydraulic problems connected with conservative conduction and distribution of water. His mathematical work in shortening and explaining formulæ relating to the flow of water is well known, and has formed the subject of various published papers of accuracy and value.

The execution of this book is somewhat a surprise, showing a vast amount of careful labor on the part of the printer as well as the author. The paper, arrangement and typography are faultless. and compare favorably with the best work done anywhere; in fact, few engineering treatises have ever had the same furtherance in "dress."

Of arrangement, meaning thereby the order of subjects and facilities for reference, we must again be so extravagant in comparisons as to claim that no other work of the kind has been better indexed. There are lists of drawings, lists of plates, synopsis of subject matter, contents and an alphabetical index. Nothing is left undone that can promote practical usefulness of the volume. The subjects are chosen in such consecution and rotation as their diversity permits, and this, we imagine, has caused the author much labor and anxiety. The result is well worth the work. It will escape the too common criticism of a "want of indexing."

The two volumes bound together make up over seven hundred pages of matter, illustrated by more than two hundred engravings and ninety-two tables of reference, explanatory of, and deduced from the author's formulæ, or his rendering of formulæ, by Kutter, D'Arcy and Bazin. Of his method the author says:

"Most of the old formulæ have *constant* co-efficients, and therefore give accurate results for only one channel, having a hydraulic mean radius of a eertain value. Only four of the authorities, whose formulæ are given in Article 3, have taken into account the nature of the material forming the surface of the channel. These are Gauchler, Bazin, Molesworth and Kutter. The value of the co-efficients in Bazin's formulæ depends on the nature of the surface of the material over which the water flows, and also the hydraulic mean depth. These co-efficients are not affected by the slope."

The tabular work in the second volume represents an amount of labor that has in some cases consumed the greater part of a lifetime. Kutter's researches on the flow of water is an example. His work, we have been informed, covered a period of thirty years, so that Mr. Flynn's tables, carried in many cases to nine decimals, represent an amount of work which his friends will not know how to reconcile with an active professional life, such as he has led.

The interminable references, all carefully given, indicate a care and respect for established authority and data that inspires confidence, especially as in nearly all cases the author has supplemented such data with his own experience and observations on this Coast.

Both the physical and economic conditions under which irrigation works are constructed here, vary vastly from some other, and especially older countries. We once heard the remark that "Almost any engineer could build a first-class railway with plenty of money, but, it required a very able one to make a long railway with a small amount of money." This applies to irrigation problems in old and new countries.

A government, constructing irrigation works for future generations, as well as the present one, is a different matter from getting water on land at a minimum outlay, and making the works over again at some future time, with the increment of land values. These things the author has kept in view, and his treatment of modern flumes in California and Colorado commands the same attention as the massive masonry aqueducts of India.

In our next issue it is proposed to notice the subject matter of the first volume, and the present space at command limits us to adding here, that as a work of reference Mr. Flynn's book is worth many times its moderate cost of eight dollars. It is published by the author at Los Angeles, California, to whom orders may be sent.

The Engineering Magazine—March, 1892.

This number comes with its usual amount of diversified matter. The essay on "High Buildings," by Mr. H. A. Goetz, is perhaps the most useful one in the number. It is not an article to quote from, but contains as a whole a large amount of technical matter known only to professional people and insurance companies, but just such information as should be perfectly understood. We all have to do with houses as owners or tenants, and high buildings concern every one as an element of a city's make up.

There is not, however, much use in contending against a system which the insurance companies seem to have stopped in an effectual manner by raising their rates. The high building craze, which Mr. Goetz condemns, was born of cupidity and ostentation, and the sooner it is abandoned the better.

The Urania Institute of Berlin is described in an article by Prof. Holden, of the Lick Observatory. It is a wonderful sort of institution for scientific instruction and amusement combined, that has been made self-supporting by a company that provided funds, and if we mistake not, is the forerunner to many more ventures of the same kind. The "Polytechnic" of London, is similar and older, but more of a popular kind. In this country we have not at this time anything of a parallel nature, but it seems Mr. Carnegie, of Pittsburgh, is considering the matter of building in New York a similar place of amusement and instruction. Prof Holden says of this matter:

"Mr. Andrew Carnegie has made arrangements for producing a few of these lectures, under the personal supervision of Dr. Meyer, at the New York Music Hall, and has spared no expense in importing all the necessary theatric "properties," so that everything may be produced in the most realistic and in the best manner. New York audiences will soon have an opportunity of judging for themselves. I think that these lectures cannot fail to be successful in every way. They are university-extension in a very practical form, and as they are planned and directed by men of real scientific attainments there is no danger that they will degenerate into mere sensational "shows." I understand that Mr. Carnegie's idea is to discover whether there is a real demand for such institutes in America, and to assist in founding them, if there is. My own experience at the Lick Observatory leads me to believe that large cities, like New York or Chicago, will gladly support such establishments, particularly if they receive the hearty support of neighboring astronomical observatories, as no doubt they will."

The nature of the Urania Institution can best be explained by the following description of one representation of last year:

"In the 'History of the Primeval World,' the spectators see the gradual evolution of the earth from the chaos of the original nebula; they see the lightning and the eruptions and hear the thunder of the tremendous struggle between fire and water as the earth gradually cools, and trace in the shifting scenery the changes which led up to its present peaceful condition."

In the term of a year there are given 313 lectures of one and a half hours each, and 582 lectures of a half hour each.

Mr. Carnegie has arranged for the reproduction of some ot these Berlin lectures in New York, as an experiment to determine whether the scheme will be populaı there.

The article by W. J. Henderson on Yachts of New York Harbor will be read with much interest by many people on this Coast, where there is a large fleet of pleasure craft in proportion to population. The account begins with 1845 and follows down to the *Gloriana*, which among all, seems to be the most marked as a departure from ordinary design.

One thing in Mr. Henderson's article will be a surprise, although not news. He says:

"In 1881 the Scotch cutter *Madge* came to this country and beat our cracks in her class so persistently that yachtsmen opened their eyes and wondered what was wrong with our boats. The lessons taught by the *Madge* were applied by the famous designer Edward Burgess, in his productions, and his work led to a line of development which totally changed the character of American yachts."

Farther on the same subject:

"Now what do these figures show? Simply that the swift little *Madge* taught our yachtsmen that beam and initial stability were very pretty things in their way, but that the vessel with staying power in all kinds of weather was the one with less beam, less initial stability, and more ultimate stability. The *Fanny*, with a beam of over 23 feet on a water line of less than 66, and a draught of 5 feet 3 inches, is a very differtype of craft from the *Volunteer* (sloop) with a beam of 23 and a draught of 10 on a water line of 86. Ever since the advent of the *Madge*, when Mr. Burgess and others saw that our skimming-dish type was radically wrong for sea work, our yachts have been growing deeper and becoming narrower; and their ballast has been going down as their topmasts have been going up."

He says that the late Mr. Burgess in 1888 came to the conclusion "that a center-board was not a necessary factor in successful windward work, but merely a matter of convenience."

This is quite the reverse of opinions commonly entertained on this Coast, and is an illustration in the line of criticisms we have offered on the whaleback type of steamers, namely: that centuries of "evolution" are not likely to be upset at once by distinctly new methods or plans.

Of the *Gloriana*, Mr. Henderson says:

"Among the crack yachts which belong to the harbor of New York, the first in importance is certainly the wonderful forty-six-footer *Gloriana*, owned by E. D. Morgan, designed and built in 1891 by N. G. Herreshoff, of Bristol, R. I. The Herreshoffs had always been known as designers of swift steam yachts, but hereafter "Nat" will rank with Burgess as a modeler of sailing craft. The *Gloriana's* record is too fresh to need repetition. She sailed in about twenty races and never was beaten, while her time, and that of her competitors, too, showed that they were all faster than seventy-footers of fifteen years ago. I take the liberty of quoting from an article of my own in an English paper: 'It is true that the *Gloriana* is a new type, but she is the result of direct development. Her sheer plan is certainly an outgrowth of the *Thistle's* visit to the United States. She is cut away forward as the *Thistle* is, and her greatest draught is a few feet ahead of her sternpost. Her bow is longer than the *Thistle's* above water (in proportion to her size, of course) and there is no break in the line running from her gammon iron to her keel. She has no forefoot at all, and this peculiarity gives her a strange appearance. Her sternpost shows less rake than those of the forty-footers built in 1890, and her forebody is perhaps a trifle longer. But the most important feature of the yacht is her water lines. Her designeı has discarded all concavity forward, thereby carrying out a line of development along which Mr. Burgess was certainly moving. The Burgess yachts of 1885 show a decided concavity in their water line forward. The later boats of this designer, however, have approached straight lines. Mr. Herreshoff has simply returned to the old theory of convex lines, a movement which it seems likely Burgess would have made very soon if he had not been cut down by untimely death. The *Gloriana's* bows flare out strongly above the load water line, and in butting a sea she has very fussy action, splashing the water out from under her lee bow in clouds of spray fifty or sixty feet wide.'"

We have long held to to the opinion that the American "skimming-dish" design was best suited for enclosed waters, and yet believe so with limitations, but we are certainly departing from the type even for lakes and bays, for as Mr. Henderson says:

"Ballast is now put as low as possible, and our yachts are given greater displacement than formerly. It can no longer be said that American boats are dangerous 'skimming-dishes,' for the new ones are good, wholesome, non-capsizable boats, able to take their chanc in all kinds of weather."

Cassier's Magazine.

In No. 4 of this fine magazine Prof. R. C. Carpenter continues his essay on Injectors, and has made plainer than we have before seen it, the mechanical theory of their operation, as follows :

"Besides the thermal efficiency, which is only concerned with the loss and transformation of heat, there should evidently be a mechanical theory to explain its action on different principles. Such a theory explains the action as the impact of a small body at high velocity—the steam in the steam tube—coming in contact with a large body moving in the opposite direction or at rest (the water in the suction pipe) and giving a resultant velocity common to the entire mass, the water in the discharge pipe.

The explanation is exactly similar to the striking of one ball against a larger one, resulting in the motion of the two balls as one with a common velocity. Thus, if w' is the weight of the steam, and such water as it may contain, and v its velocity, its momentum is $w'v \div g = m$; if W is the weight of water lifted, and its original velocity deduced from the suction-head be negative and equal to V', its momentum is

$$WV' \div g = M'$$

If V is the velocity of discharge, the common momentum is

$$M = (W + w')\ V \div g$$

By the principles of impact,

$$\frac{w'v}{g} + \frac{WV'}{g} = \frac{(W + w')V}{g} \quad (1)$$

but because of loss of force by eddies and friction, $w'v$ will be greater than the second member of the equation."

Mr. W. H. Wiley, C. E., of New York, contributes to this number an article on Mr. James Dredge, of the journal *Engineering*, London. He is the best known in this country among eminent English engineers, and who, as Mr. Wiley says, "has done more to promote a kindly sentiment for Americans in England, than all the interchange of courtesies combined."

This is easily true, and is enabled by a capacity for executive work which has, perhaps, few parallels. Mr. Dredge, whom we have the honor to know very well, since 1870, is an embodiment of power, physical and mental—one quality supplements the other, and these reinforced, so to speak, by opportunities such as few can enjoy, have produced what Mr. Wiley claims, a modern engineer and man, of the highest type. The most interesting among the facts given in Mr. Wiley's article, is that in respect to the partnership between Mr. Dredge, Mr. Maw and Mr. Hollingsworth, the owners of *Engineering*, an arrangement that has lasted twenty years without jar or friction. It is remarkable that the government has not conferred on Mr. Dredge the civic distinctions accorded to eminent and useful engineers in England, but this will follow no doubt.

His part in promoting European interest in the American Exposition of 1893 has been in a sense to create it, not only in England, but over that wide field covered by *Engineering*—a field as wide as the name indicates, and one gained by a policy that has always refused to recognize national lines in work, universal by its very nature.

This article of Mr. Wiley's will be read with much interest by thousands in this country, who have wondered how *Engineering* was "built up."

An article by Mr. E. P. Allen on the production of aluminium contains the first attempt we have seen at popular explanation of treating fused metal, or in other words, the employment of electricity in reduction processes. In respect to aluminium Mr. Allen says :

The electrolysis of fused masses is a subject of such recent growth that it has so far had very little thorough study. It is a subject of many inherent difficulties. It is not a simple matter to discover reaction or other operations in a molten mass, though, to be sure, there is very little firm ground in any sort of electrolysis. In the present case there is a question as to whether the cryolite—rather, its aluminium fluoride constituent—or the alumina is the electrolyte; that is to say, whether the cryolite acts simply as a solvent of alumina and the latter is directly decomposed, or the aluminium fluoride in the cryolite is decomposed and continually regenerated by the combination of the fused fluorine with the aluminium of the continually added alumina. There is much to be said on both sides, and authorities differ. Among inventors, Hall and Héroult, judging from their patent specifications and subsequent utterances, consider that alumina is the electrolyte and that the cryolyte plays simply the part of a solvent, possessing in addition to its remarkable power of solution the advantage of a lower specific gravity than that of aluminium, thus allowing the molten metal, as it is separated, to collect in the bottom of the pot or preventing its rising to the top in the nascent state and recombining with oxygen in burning. Minet, on the other hand, believes that the fluoride is the electrolyte, and the alumina, continually added, regenerates the bath, and Minet, it would seem from his learned papers in French electrical journals, is more competent to express an opinion than his confréres''

This article, which is to be continued next month, will be the most instructive essay on the subject of aluminium, technical, historical and commercial, that can be referred to.

Professor Jamison's article on rotary engines should be a very useful one. He has recently been called upon to investigate the performance of a rotary engine made with all the care possible, and to embody all the best features of such engines. The result was a consumption of 31.47 pounds of water per indicated horse power per hour, which is certainly encouraging as to economy. The problem of endurance, which is the main one, could not of course be determined, but can have in our opinion only the common one of failure, delayed perhaps by workmanship and care, but perishable as are all contrivances that violate a fundamental law of construction, or operation, rather.

Professor Jamison's description of methods for making diagrams from such engines will be a matter of interest to those who have attempted the like.

How to Run Engines and Boilers.

Mr. Watson of the *Engineer*, New York, sends us a copy of this little book, written by himself and first published in serial form in his journal. The matter is now bound in a neat, well-printed volume of 125 pages, and contains a portrait of Mr. Watson, which will be a matter of some interest to many who read the *Engineer*, and to others. Mr. Watson is one of the few practical men who have been able to temper their writings with the salt of experience, and is still more conspicuously one that never fears to state what he deems truth. The success of the *Engineer* has from the beginning been owing to this quality coupled with a very extended knowledge of constructive work, and the means of its accomplishment.

The present book consists of various rules, suggestions and instructions to be observed in the care of engines and boilers, or ''run'' them, as we say in this country. It is a friendly talk, made interesting by an avoidance of a didactic style common to such manuals. The following quotation will serve to show the general style of treatment.

''The object of putting lap on a slide valve is to cut off the steam early in the stroke of the piston. Suppose the steam end of the valve had no lap at all, but barely covered the steam port; then so soon as the piston moved the valve would open and continue opening, closing barely in time to open again for the return stroke of the piston. Now suppose we add one quarter of an inch lap to the valve; then the valve would open just as soon as it did before, because we have advanced the eccentric to permit it to open, but it would close sooner by the amount of the lap, because we have stolen, so to speak, a quarter of an inch from the travel of the valve by advancing the eccentric; therefore, if it closes sooner it cuts off the live steam earlier in the stroke; but as explained previously, it cuts off the exhaust also. We introduce this as an illustration of the uses of lap. Laps on slide valves vary all the way from half an inch upon a twenty-five horse-power engine to one inch and upward on high power engines.''

The book is published by the author at 150 Nassau street, New York, price $1.50.

Statistical Report of Interstate Commerce Commission.

The Interstate Commerce Commission, whatever its influence may be in the regulation of rates and fares, has proved a bureau of importance in the compilation of statistics. The third annual report, just issued in an advanced and abridged form, shows a wonderful amount of labor, and gives a confidence of accuracy such as would not attach to a similar work performed by officers clothed with less authority. It is difficult to select among the various divisions of the report any one that will be of most interest. That on accidents is appalling, and has called out in the *North American Review* two essays, neither of which lead up to any hopeful means of prevention. Mr. Cabot Lodge's article in the February issue gives the killed in 1890 at 2,451 persons, but the Interstate Commission says this many employed people were killed, besides 3,833 other persons, or a total of 6,334. The injured are set down at 29,025. The number of employed is given at 749,301, which shows one death for every 306 persons, and one injury to every 33. A person riding continually would by a computation of chances be killed within 158 years, but trainmen must expect death in 35 years. Coupling accidents are most common; 369 people were killed, and the total of accidents in this operation was 7,842 for the year 1890.

The Technology Quarterly.

This finely printed serial is issued four times a year, by the Massachusetts Institute of Technology, and contains usually six or more essays of much value on technical subjects, scientifically treated.

The current number has an able paper on the application of Hirn's analysis to multiple expansion engines, presented at the Providence meeting of the Mechanical Engineers in 1891. It is in the main a mathematical evolution of the thermal quantities, or resultants of these, set forth in forty-nine formulæ accompanied by a lengthy table of results from tests, made by the graduating class, on the new triple expansion engine for experimental purposes made by the E. P. Allis Company, of Milwaukee, for the Institute.

This engine forms the subject of another essay in the same number accompanied by drawings to show the construction, which seems to be quite the same as ordinary service engines, made by the firm.

We are far from thinking this the best design that could have been adopted for an experimental engine, but so long as the Corliss type of valves are so extensively used, there is that much in favor of the design, even if it fail to permit some kinds of experiments, high speed among them.

"An Experimental Study of the Waste Field of Dynamos," presents one of the foremost practical essays in electrical science that has appeared for some time.

The Prospector's Field Book and Guide.

BY PROF. H. S. OSBORN.

Messrs. Osborn & Alexander send a copy of this book for notice. It is in a sense supplementary to Prof. Osborn's more extensive works on metallurgy and mining, and permits of commendable notice for various reasons.

It contains an ingenious sifting from the broad subject of mineralogy of such things as occur, or should be known by those who search for and determine the value of mines, and as indicated in the title, is for "prospectors." This being the ostensible and particular object of the book, will not hinder its use in a popular way by those living in mining regions and interested in mining matters, and this we imagine will require five copies where one goes into the hands of a prospector or searcher for minerals. It can be profitably read for its geological part, for analysis, for information concerning metals, and even precious stones; also, for instruction in the use of the blow-pipe, concerning which the information is complete.

We have received from Messrs. Osborn & Alexander a copy of "A Manual of Mining," by Professor Ihlseng, of the Colorado School of Mines, which will be noticed in our next issue.

Illustreradt Sverige.

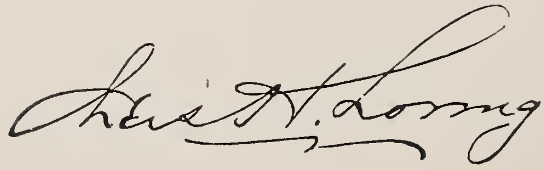
This means, in English, "Sweden illustrated." We have received a copy with the announcement that the edition is soon to be issued in English, and when it is, there is no guide book that can be of more value to American tourists. It is wonderfully well "got up," profusely and finely illustrated, and has only the fault we can see of being confined to middle and southern Sweden.

The northern provinces, especially Dalcarlia, are to travelers most interesting, because here have lingered the manners, customs, and even dress, of two centuries ago. The people of Dalcarlia (men of the dale, or valley) discourage intermixture with their people. They are sturdy, honest, intelligent, and have a kind of dread of what we call modern civilization.

The 23 maps in the present guide are a marvel, executed in a perfect manner, with copious references, and will enable a traveler to go understandingly over all the routes of travel.

In connection with this notice, we will take occasion to say that the usual route of American travelers through Southern Europe to see "beggars and pictures," as some one has sarcastically called it, is a mistake, for at least those who are of a philosophical turn and taste.

In the North there are old things to see as well as in the South. There are no beggars, but a great many pictures, and we can see there our "forefathers," also the "mora stone," the cradle, so to speak, where self government originated among our race.



PRESIDENT

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

"INDUSTRY."

JOHN RICHARDS, Editor.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

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Founded 1888. MAY, 1892. No. 46

THE MECHANICAL ENGINEERS.

The convention of the American Society of Mechanical Engineers, to take place in this City on the 16th, 17th and 18th of the present month, is an event of much importance, and while some allowance must be made for any estimate of the matter coming from a technical publication, we feel warranted in assuming that no other visit of the kind, to this Coast, has deserved so much attention.

Whatever has to do with skilled industry, which is the very center and soul of our prosperity and place in modern progress, is worthy of profound attention, and our industries and procedure here are about to be subjected to the scrutiny and criticisms of the most eminent and successful men that our country has produced, men who have moulded and made our place in the skilled arts among the nations of the world—a place of especial rank and one not attained in many other branches of science and the arts.

A large number of these visitors have not only a national but an international reputation, earned by "works," which is the only means of professional eminence among mechanical engineers.

Visits here, in time past, of various associations have met with royal welcome, and deservedly no doubt, but, as before said, on no previous occasion has there been a case like the present one. Our sole hope of maintaining the various industries of this Coast, on which so much depends, lies in our skill and reputation. In this visit our skill will be weighed and measured, and our reputation settled in so far as the opinions of several hundred of the most skilled engineers of this country, and of thousands who look to

F. R. Hutton.

SECRETARY

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

them for opinions and facts. There are resources, already liberally tendered, to entertain our visiting friends in a becoming manner, but there is much to do yet, which will, no doubt, be carried out in a manner worthy of the City, the Coast, and the Profession.

There are at present about 1,400 members of the American Society of Mechanical Engineers, of which there are a number on this Coast. The Society owns a fine building in New York, fitted up as a library, hall, offices, reception rooms, and dormitories for non-resident, visiting members. It is the largest and most active among the technical associations of this country, or of its kind in any country.

The portraits of the executive officers, which have been engraved for this issue, together with the following short personal notice, will be a matter of interest to our readers.

The President, Mr. Charles H. Loring, is a native of Boston, Mass., Commander in rank in the U. S. Navy, and formerly Chief of the Bureau of Steam Engineering. His services have been eminent and successful, both in an executive and scientific sense. He participated in the celebrated battle between Ericsson's *Monitor* and the *Merrimac* in Hampton Roads, and served in responsible positions throughout the war from 1861 to 1865. President Loring is now on the retired list of naval officers, and in position to give attention to the important Society over which he presides.

Professor F. R. Hutton, the Secretary of the Society, is a graduate of the Columbia College School of Mines, and was an instructor, and finally full Professor there of mechanical engineering, a rank he still retains. He has been Secretary of the Society of Mechanical Engineers since 1883, and, in that capacity, has discharged the multifarious duties, which, in this country, are condensed under the head of "secretaryship" meaning thereby the conduct of all executive business, under the board of direction and council.

Mr. William H. Wiley, the Treasurer of the Society since 1884, is a civil engineer, also an engineer of mines, with a successful practical record in both branches, as well as in the military service of the country. He has an extended personal connection in cognate branches of engineering, and is a member of the well known publishing house of John Wiley & Sons, New York. He is also the New York representative and correspondent of *Engineering*, London.

The following circular has been sent out to various influential people here, by the provisional committee of reception in this City. It contains a good deal of information not embodied in the preceding remarks :

TREASURER

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

"The American Society of Mechanical Engineers is one of the largest technical associations in this country, and has among its members many persons of international reputation. The objects of this Society are to promote the arts and sciences connected with engineering and mechanical construction by means of meetings for social intercourse and the reading and discussion of professional papers.

To be eligible as a member, a candidate must have been so connected with certain professions as to be considered, in the opinion of the council, competent to take charge of work in his department, either as a designer or constructor, or else he must have been connected with the same as a teacher.

Mechanical, civil, military, mining, metallurgical and naval engineers, and architects of eminence are to be found enrolled in the list of, and are, eligible as members. All the technical schools and colleges of the United States and Europe, where the sciences and arts are taught, are as a stepping stone to membership in this society. Our State University at Berkeley, and the Leland Stanford, University of Palo Alto, are now paving the way for California's young men for membership.

From this it will be seen that these mechanical engineers, who propose crossing the continent to hold their Spring Session in the Academy of Sciences building in this City, are not merely people who can run a locomotive or construct a stationary engine, but they are skilled professional men of all arts, competent to design or construct all kinds of engineering work. Chas. H. Loring, its present president, was chief engineer of the North Atlantic blockading squadron during the first eighteen months of the civil war, and participated in the famous battle between the *Monitor* and the *Merrimac*; and the honored and lamented Ericsson who designed the *Monitor*, was a member.

In the summer of 1889 this society chartered the Steamer *City of Richmond*, and crossed the Atlantic to visit their professional brethren in England, France and Germany. In London the party was formally received at the house of the Institution of Civil Engineers, by the president, council and members. On the evening of the same day the Lord Mayor, Aldermen, and Court of Common Council of the City of London tendered them Guild Hall, where they were banqueted. This in itself was an exceptional honor. In gracious response to an application to the Queen, Her Majesty directed that special facilities should be afforded for visitors to Windsor Castle, including the private apartments of the palace, and to St. James and Buckingham Palaces. The Archbishop of Canterbury personally showed and explained the objects of interest at Lambeth Palace; while the Dean of Westminster delivered, in the Abbey, an address on the historical associations of that building.

Among the purely social entertainments offered were, a garden party by the Baroness Burdett-Coutts, a reception by Lord Brassey, K. C. B., Associate Member Institute of Civil Engineers, and a dramatic performance in the grounds of Copped Hall, by invitation of Mr. S. B. Bolton, Associate Member Institute of Civil Engineers, while those having facilities for doing so vied with one another in their efforts to afford the visitors amusement and recreation during the six days of their stay in London. Special trains were granted by the principal railway companies to various places of engineering interest in and around London.

The trip of the Society to California partakes somewhat after their trip to Europe. They will leave New York on Wednesday May 4th, in special Pullman trains, visiting places of interest enroute; will arrive at Sacramento May 13th, where the afternoon will be spent; thence to Monterey, where they will remain at the Hotel del Monte over Sunday, arriving at the Palace Hotel, San Francisco, Monday, May 16th, upon which day their first meeting session will be held at the Academy of Sciences building.

Their stay in San Francisco as an organized body will extend to May 19th, during which time many valuable papers will be read and discussed, and municipal courtesies extended to them, as well as private entertainments, and visits to engineering works and other places of interest near our City.

A large local committee has been selected to assist in the entertainment of the distinguished visitors.

W. R. ECKART,
Chairman.

CHAS. G. YALE,
Sec'y of Local Committee.
220 Market Street, San Francisco.

A PERFECT RAILWAY CURVE.*

BY D. E. HUGHES, C. E. Mem. Tech. Soc.

INTRODUCTION.

In railway location it is desirable that circular arcs be not connected direct to tangents, but eased off by a line of diminishing curvature. This is done now in several different ways.

Some make the transition by compounding circular arcs of finite length, thus removing part of the evil and permitting the remainder to be met on the installment plan.

Others make the change by means of the cubic parabola of which a short length of small total curvature very nearly coincides with the perfect transition curve.

Still others make the "easement" by some indefinable, indescribable thing that is not a curve at all in a mathematical sense, not

*From a paper presented before the Technical Society of the Pacific Coast, April 1st, 1892. Reprinted by permission.

conforming throughout its length to any one law, and incapable of being extended beyond narrow limits.

Very rough locations are by some called "good enough" on the grounds that track-layers do not follow exactly any given location: but, other things being equal, is it not better that these unavoidable deviations be from the perfect curve?

Some too, make overmuch of saving a few minutes' time in calculating, forgetting how small need be the advantage of a better curve on a good road with heavy traffic, to soon repay the extra cost. This is not a criticism on approximate methods in general. Any easement is better than none at all, and several of the curves in use are very good within the limits intended for them. But it would be better to have uniformity of practice. Men could work together to better advantage, and time would be saved in school if but one transition curve was in use.

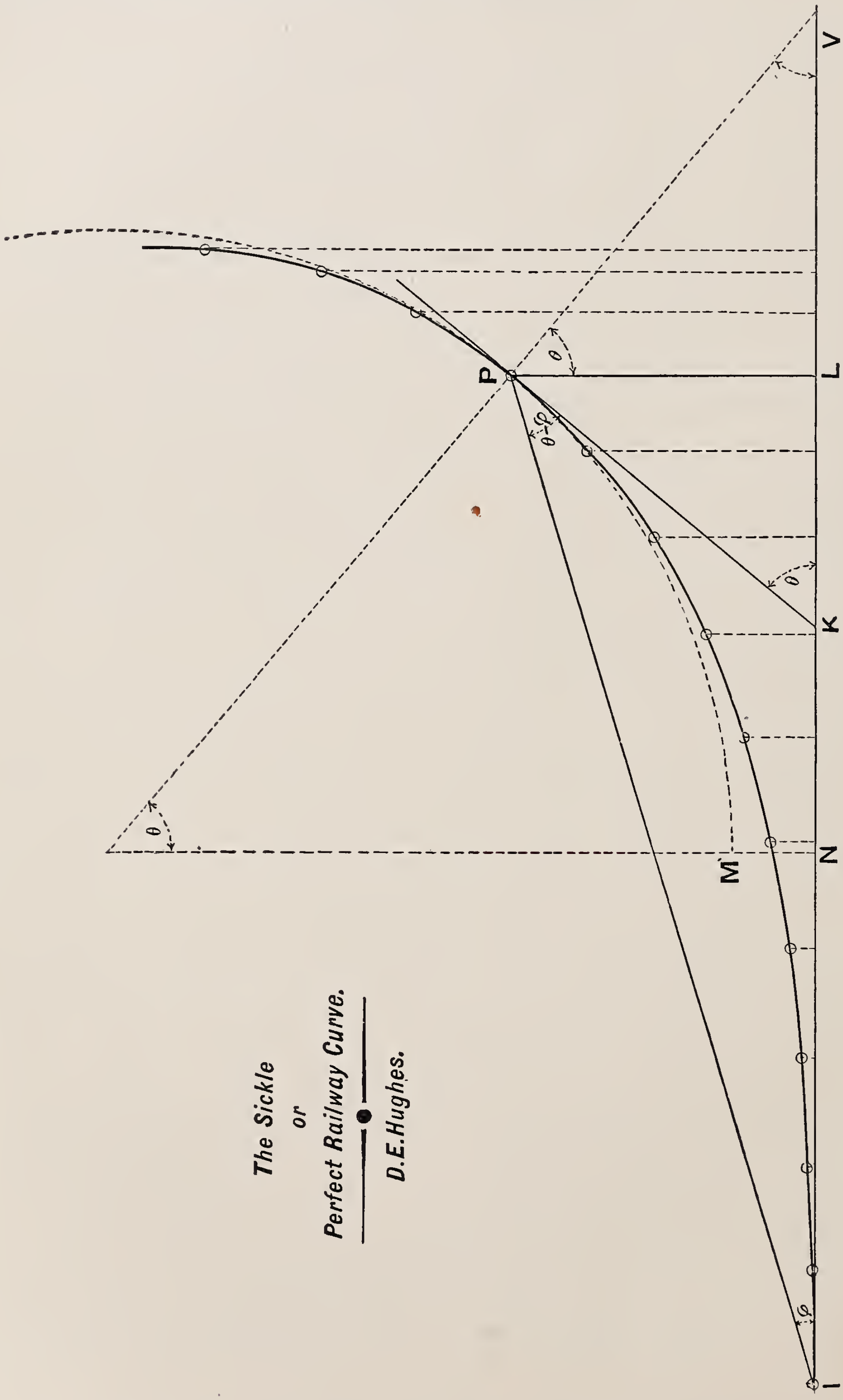
The curve adopted should be the most perfect practicable, to meet the high precision that all field work is rapidly approaching. It should be determined independently of any other curve so that a line containing it can be described as definitely and briefly as can one composed of only tangents and circles.

The curve required has been defined by several. For a correct idea of it, conceive a curve compounded of infinitesimal circular arcs of uniformly varying curvature. Evidently this curve if begun with an infinite radius, has at any point a curvature directly proportional to its length, hence the superelevation of the outer rail may begin with the curve and, but for the excess of gauge of track over its horizontal projection, increase uniformly. If this excess is considered then the tangent, not the sine of the lateral slope must increase uniformly. Luckily the track can be laid in conformity with the latter plan with the same facility, and to meet the fast trains of the future, it may be done.

The following pages contain the curve described above, the principal equations relating to it, and its more important functions tabulated.* The tables contain more decimal places than would usually be necessary in practice, but they have been retained that interpolation may be more accurately effected, and in order that finer discrepancies between this curve and those in use may appear. To obtain a working knowledge of these equations and tables in the least time would require that they be illustrated with solutions of

*Want of space compels the omission of Prof. Hughes' tables, covering ten pages. These are published in full in the Transactions of the Technical Society of the Pacific Coast.

many of the different problems likely to occur in practice, but so much detail would encumber this paper too much, hence only the skeleton with brief explanations, is submitted.



The table has been extended to 90 degrees in order that great lengths of this spiral may be located, for it is often the case that it fits the ground better and is easier to locate than a compound curve composed of several circular arcs connected by "easement" curves.

A location can be made by means of this curve without using circular arcs at all, hence it should not receive a name that would seem to limit its application—should not be called "transition curve." In this paper it is called *sickle*, suggested by the resemblance of the first 90 or 100 degrees of it to the old reaper's sickle.

DEFINITION.

The "sickle" is a plane curve whose radius of curvature varies inversely as its length measured from its initial point.

EQUATIONS DEDUCED.

In Figure 1 let the origin of coördinates be I, the initial point of the curve, and P any point on the curve. $x =$ I L. $y =$ P L. R = radius of curve at P. $c =$ chord I P. $s =$ length of curve I P. $t =$ tangent I V. $f =$ offset M N. $\theta =$ total curvature of arc I P. $\phi =$ deflection angle of point P. X, Y, C, F, and T represent those functions of θ displaced by them in the equations where they first appear.

From the definition, $R = \frac{k}{s}$ (*a*) where k is a constant, but

$$R = \frac{ds}{d\theta} \text{ the general formula for radius of curvature.}$$

Therefore, $\frac{ds}{d\theta} = \frac{k}{s}$

Integrating and reducing, $s = \sqrt{2k\theta}$, (*b*) the intrinsic equation of the curve.

From (*a*) and (*b*) $s = 2R\theta$ (1), or twice the circular arc MP.

From (*b*) $\theta \propto s^2$ (2)

TO TRANSFORM TO RECTANGULAR COÖRDINATES.

$$\left.\begin{aligned} dx &= ds \cos.\ \theta \\ dy &= ds \sin.\ \theta \end{aligned}\right\} \text{General formulæ of transformation.}$$

Differentiating (*b*), $ds = \sqrt{\frac{k}{2\theta}}\, d\theta$

Substituting,
$$\left\{\begin{aligned} dx &= \sqrt{\frac{k}{2\theta}} \cos.\ \theta\, d\theta \\ dy &= \sqrt{\frac{k}{2\theta}} \sin.\ \theta\, d\theta \end{aligned}\right\}$$

Integrating :

$$x = s\left(1 - \frac{\theta^2}{5.2!} + \frac{\theta^4}{9.4!} - \frac{\theta^6}{13.6!^*} + \ldots\right) \text{ or } x = s\text{X} \quad (3)$$

$$y = s\left(\frac{\theta}{3.1!} - \frac{\theta^3}{7.3!} + \frac{\theta^5}{11.5!} - \frac{\theta^7}{15.7!} + \ldots\right) \text{ or } y = s\text{Y} \quad (4)$$

In right triangle I P L :

$$\phi = \tan^{-1}\frac{y}{x} = \tan^{-1}\frac{\text{Y}}{\text{X}} = \frac{\theta}{3} - \frac{8\theta^3}{2835} - \frac{32\theta^5}{467775} \ldots\ldots \quad (5)$$

$$c = \frac{y}{\sin.\phi} = \frac{s\text{Y}}{\sin.\phi} \text{ or } c = s\,\text{C} \quad (6)$$

$$f = s\,\text{Y—R vers. } \theta = \text{R }(2\theta\text{Y} - \text{vers. } \theta) \text{ or } f = \text{R F} \quad (7)$$

$$\text{developing F, } f = \text{R}\left(\frac{\theta^2}{6} - \frac{\theta^4}{168} + \frac{\theta^6}{7920} - \frac{\theta^8}{604800} + \right) \quad (8)$$

$t = \text{I L} + \text{L V} = s\text{X} + s\text{Y} \tan.\theta = \text{R }(2\theta\text{X} + 2\theta\text{Y} \tan.\theta)$ or $t = \text{R T}$ (9)

Area between chord I P and curve =

$$s^2\left(\frac{\theta}{12} + \frac{\theta^3}{105} + \frac{4\theta^5}{31185} + \ldots\right) \quad (10)$$

TO LOCATE THE CURVE.

Suppose a length s, of 10 stations, and total curvature $\theta = 50°$.

From eq. (2) the direction of the curve at the several stations ; that is, the several values of θ are as the squares of 1, 2, 3 . . . . 10. Since the last is 50°, the first is $\frac{50°}{10^2} = \frac{1}{2}$, and the others 4, 9, 16, etc., times this, or

½°, 2°, 4½°, 8°, 12½°, 18°, 24½°, 32°, 40½°, 50°.

TO LOCATE THE STATIONS BY OFFSETS FROM TANGENT.

With argument ½°, 2°, 4½°, etc., take from X and Y columns the corresponding decimals multiplying them, as per (3) and (4), by 1, 2, 3, etc., times a station length respectively. The results are the

*13.6! means 13 times 6 X 5 X 4 X 3 X 2 X 1.

abscissæ and ordinates of the stations, and for stations of 100 feet are as follows:

STA.	θ	x	y	STA.	θ	x	y
1	½°	99.999	0.291	6	18°	594.105	62.390
2	2°	199.976	2.327	7	24½°	687.308	98.480
3	4½°	299.815	7.851	8	32°	775.404	145.650
4	8°	399.221	18.591	9	40½°	856.060	204.609
5	12½°	497.627	36.238	10	50°	926.484	275.443

TO LOCATE THE SAME POINTS BY LONG CHORDS AND DEFLECTION ANGLES.

Use same argument as before and obtain values of ϕ and C multiplying latter, as per eq. (6), by 100, 200, 300, etc., respectively. The results are the deflection angles and long chords from I to the other stations, and are as follows:

STA.	ϕ	C	STA.	ϕ	C
1	0° 10′ 00″	100.000	6	5° 59′ 42″	597.372
2	0° 40′ 00″	199.989	7	8° 09′ 14″	694.328
3	1° 30′ 00″	299.918	8	10° 38′ 18″	788.964
4	2° 39′ 58″	399.654	9	13° 26′ 32″	880.172
5	4° 09′ 54″	498.943	10	16° 33′ 26″	966.562

The deflection angles may be used and each point located by measurement from the last preceding one. This measurement, however, must not be 100 feet, for in this work a station length is measured *on the curve.*

The error made, if this point is disregarded, is very small at first, but it is cumulative, and it will throw the curve outside of the one aimed at and make it longer—a very good curve still, but the traverse in the field will not agree with that in the office.

To find radius of curvature at any station, use eq. (1), where $R = \frac{s}{2\theta}$. In this particular case, at station 8, for instance,

$$R = \frac{8 \times 100}{2 \times .5585} = 716.20.$$

The decimal in the denominator is the value of 32° in circular measure, and is found with it in the first column of the table.

An equivalent result is more quickly obtained by noting that 8 stations consume, in this case, 32°, an average of 4°, and as curvature at start is 0, and increases in arithmetical progression, the degree of curve at close is twice the average, or 8°.

In present practice it is often the problem to locate the curve, having given the degree or radius of circular arc and offset M N. The relation between the given quantities and θ is expressed in (7) or (8), and the function of θ therein is tabulated in column headed "F."

Suppose radius of circular arc = 572.96 — and offset M N = 70. 78 — . 70.78 ÷ 572.96 — = .1235 +. With this as argument in column "F" take from first column the corresponding θ, which is 50°, or .87266. Now by eq. (1) $s = 2 \times 572.96 \times .87266 = 1000$ feet. Take from the same place in the table $\phi = 16° \; 33' \; 26''$, and 1000 times C 966.56. Now having chord P I, and angle I P K 50° — 16° 33′ 26″, locate I, and then the curve.

TO FIND LENGTH OF TANGENT IV WHEN ONLY SICKLES ARE USED.

Suppose external angle at V 100°, and that two equal sickles are to be used, making the sharpest curvature at vertex 10 degrees. $\theta = 100° \div 2 = 50°$. Take from table X Y, and circular value of θ corresponding to 50°, then substitute these, tangent 50°, and radius of 10° curve in eq. (9), to obtain t. The quantity in parenthesis in eq. (9) is tabulated, (as yet only to 30°) and appears in the last column T. If a circular arc of a given radius is to intervene, let θ be angle consumed by each sickle. The circular arc must consume the rest of the exterior angle $\triangle$ (not shown in Fig. 1), or $\triangle - 2\,\theta$, and tangent can be found from the following equation, not previously given:

$$t = R \left\{ [1 + F] \tan. \tfrac{1}{2} \triangle - \sin. \theta + 2\,\theta\,X \right\}$$

The foregoing examples are purposely simple and few in number, the intention being only to illustrate the equations and show what the tables contain. Concerning additional and more complicated problems that may arise, suffice it to say, that, since the sickle is a mathematical curve, they can all be solved. Passing obstructions, etc., can all be readily done with a little more work in calculating, however, than is required with the circle.

TO DRAW THE CURVE.

The equations show that *all sickles are similar*, hence to draw any arc of the curve all that is required is one well-constructed sickle and a pantograph. The pattern should be on material that will preserve its *form*.

Further, some scale should be *assumed* for it, and points where, according to this scale, the radius of curvature agrees with the radii of 2, 3, 4, etc., degree curves should be marked and portions of such radii drawn, so that the plate can be more quickly adjusted relatively to the map, and so that just such portion of the pattern may be used as will reproduce on the map the arc required, and no more.

The pantograph and pattern are mentioned only as a *complete* solution — as a plan to draw the sickle to any scale. Perhaps the draughtsman would be better suited by having several patterns without the pantograph—patterns conforming to the scales of his drawings and to be used as rulers.

These sickle rulers to be most handy should be marked with radii, etc., as described above. Again, transparent paper may be used with the required sickles, markings, and all, printed thereon, and the curve traced; or the paper may be used to prick the important points, and the corresponding ruler to draw the line. Sickles, being similar, may, like circles, be denominated as "20 minute," "3 degree," etc., a "40′ sickle" meaning one in which the *first 100 eet* of it curves 40 minutes; that is, one in which the degree of curve at the beginning is 0, at the middle, 40′, and at the end of the 100 feet, 1°, 20′.

APPROXIMATIONS.

When θ is small, eq. (5) shows that $\phi = \frac{1}{3}\theta$ *approximately*. Referring to the table, it is seen that not until θ reaches about 21° 20′ is the error so much as 30″. In eq. (4) when θ is small, $y = s\frac{\theta}{3}$ *nearly*, and combining this with (2) gives $y \propto s^3$ *approximately*. These two equations, deduced in a different manner, however, give the curves of a recent writer. Since, as seen in (3), s exceeds x but little when θ is small, an approximation to the above approximation is $y \propto x^3$, the cubic parabola, used now by several.

By rejecting all of the series after the first term in (8), and combining with one, there results $s = \sqrt{24 R \times \text{offset}}$, a property of the first good "curve of adjustment" ever used.

A fair approximation to any of these is the "elastic curve," which, with considerable trouble, may be drawn with an elastic ruler.

SAMPLE OF NOTES.

NO OF STATION.	KIND OF LINE.	BEARING AT FAR END	DISTANCE.
23	Tangent	N 40° E	400 feet
27	Sickle	N 46° E	300 "
30	Circle	N 66° E	500 "
35	Sickle	N 80° E	400 "
39	Circle	S 79° E	700 "
46	Sickle	S 67° E	300 "
49	Sickle	S 53° E	400 "
53	Sickle	S 50° E	300 "
56	Tangent		

EXPLANATION.

The sickle beginning at station 27 turns through 6° in a length of 300 feet, or an average of 2° per 100 feet. As it begins with 0 curvature, it ends a 4° curve, hence, what follows must begin with that. The next is a circular arc of 20° total curvature, and being 5 chains long is a 4° curve as required. Next a sickle 4 chains long through 14°, average curve 3½°, beginning as a 4°, therefore ending as a 3° curve. Next a 3° circle. Next a sickle of 12°, 3 chains long, beginning 3°, average 4°, ending 5°. Next a sickle of 14°, and 4 chains, average a 3½° curve, beginning 5°, hence ending 2°. Next a 3 chain sickle turning through 3°, an average of 1 degree per chain, beginning a 2° curve, and ending *straight* in a direction S 50 E.

It is evident that some arc of any sickle will unite with any arc of a given sickle without causing a *finite* change where the arcs join. By thus compounding, any direction required at the extremity can be attained even without altering the total length.

A simple sickle can be made to pass through any three points.

A compounded sickle will go anywhere.

SKILLED LABOR ON THE PACIFIC COAST.

In the *Californian Magazine* for April there is an article by Mr. John Bonner on the above subject, a single column of which has more practical value than all the lampoons, cartoons, and general "grass throwing" that has appeared in three years past, and this estimate is based on its facts and statistics alone.

The writer, who appears to be thoroughly familiar with the subject, has, however, stopped short of both cause and remedy, either of which, inference tells us, he could treat in an equally useful manner if he so desired. He explains how the distance from other labor centers, and a thorough organization of the unions, has enabled the maintenance of wages here at an abnormal rate, and how rule after rule affecting individual production has been enacted and put in force by the unions, and how the industries of the City have, in all cases, suffered, and in some been destroyed. A presentation of such facts is certainly something in the way of a remedy, a *post facto* one. It is not the remedy to prevent and, perhaps, not one to much alleviate the wrongs that have grown up under a system that constitutes the employed and unemployed commercial enemies, with different and opposite interests.

In all such cases when men of average reason are to be dealt with, the first thing should be to search for and discover the theories that lie at the bottom of their opinions. Men do not strike and exact abnormal wages without some theory that is held and discussed, and which appeals to their reason. This is apparent in all their proceedings. There are theories of overproduction, demand and supply, prices which consumers can or should pay for products, the effects of apprenticeship, and, it is not amiss to say, that through all these labor quarrels the workmen have been following on what to them, is a consistent theory of their rights, and what they are warranted in exacting.

We have watched the literature on this subject, such as workmen read, and have the first case to find where the laws governing wages have been laid down or explained, or where men have been shown what their wages can be, and cannot be. The ethical treatment of the subject is not worth referring to, much less reading.

Men care nothing for moralizing. It only arouses their suspicions, and we exclude all such matter from a practical treatment of the subject.

It is true in some cases people have been at the pains to show how high freight charges, high expenses, the extra cost of material, and the greater division of labor in Eastern factories make the present high wages here impossible; in some cases too, the actual labor cost of some commodities have been given to show an excess here, but the ground principle, so to speak, on which industries here and elsewhere, must rest, has not been taken up and presented to the men in a manner to convince them that there is a limit to wages, and that, by the plainest laws of economics, labor cost must be a "fixed amount" or "uniform amount" in any industry that survives.

Of this we will speak further on, and for the present continue to point out how there has not only been no presentation of such a law or principle, but much writing and talking that has led to an opposite view, that is, that wages are an accident, and may be more or less as certain rules or the power of certain combinations may determine.

THE ACCIDENT THEORY.

Next to the domestic affairs of life, among which is wages, politics most concern the working man. He believes, and is taught, that certain laws, modes of taxation and governmental policy, can determine the amount of work to be done and the price he is to receive for performing it.

He is thus told that the rate of wages is accidental or arbitrary, and as a natural consequence he sets out to raise wages as much as possible, using all means within his power to enhance the value of the commodity he has to sell, just as other people do. He is told that prices are a local affair, and, for anything shown to the contrary, have no limit so long as the consumer of his products can be compelled to buy them. He is also taught that high prices for material produces high wages, or rather that the causes which enhance the cost of material, also increases wages. This looks, on its face, as a true proposition. When iron costs $60 per ton here and $30 per ton elsewhere, it follows by parity of reason that wages here should also be double, and the assumption is not far wrong in so far as equity, but wholly impracticable in fact, as we will show further on.

When this sort of logic is not dealt out to workmen, the demand and supply theory takes its place, that is, that wages must depend upon the number of workmen, and an assumed constant amount of work to be done. This is also a branch of the accident theory, teaching that wages can be determined arbitrarily.

With such teachings as these why should not men employ every kind of means to raise their wages and recognize no limit? It is but following out a logical conclusion with the same, or even less, selfishness than characterizes other pursuits. The workman finds nearly all the necessaries of life which he purchases, bear an arbitrary price, fixed by the government and by combination just as he attempts to do in respect to his wages. There is no limit to these prices so long as the consumer is forced to buy in the home market, and there is not even this limit to his wages, why then should not these be raised under the "accident" theory to the utmost limit, or to all that can be exacted? We say "accident" theory meaning thereby one which assumes the causes which determine prices in other cases do not apply to labor, and that wages may be high in one place and low in another.

Volumes have been written to prove this matter, showing how the "rate" of wages is high in one country and low in another, when, as a matter of fact, the amount of wages is nearly uniform in all countries, and must be, to maintain the balance of commercial cost. A man may receive 60 cents a day in Germany, 30 cents a day in Japan, and $3.00 a day in America, and the labor cost of what is produced be just the same in the three cases.

This is not explained, however, and American workmen are taught to believe that this difference of rate is an accident, or due to some occult causes not explainable on simple grounds. He thus forms an opinion that the same causes which make his wages five times as much as in Germany or ten times as much as in Japan can just as well continue to raise the rate. In other words, American workmen never find, in the literature of the subject, any explanation of the difference between the "rate of wages" and the "amount of wages," consequently the common doctrine may be called the "accident" one.

THE LAW OF WAGES AND PRICES.

The law of wages is a very simple one when approached from a commercial standpoint, and without mystification. There is no mystery in the matter, or at least need not be, when we admit that commodities produced by labor have an international or world's value—one determined in the neutral markets, for all kinds of staple commodities.

There is no staple product that can be named, from steamships to pins, from silk to straw, or from pig iron to platinum, but has such a value that can be read off daily in the lists of current prices, and such values are of necessity uniform unless affected by impost taxes, and these relate only to local prices where the impost is levied. Metals, cloth, leather, timber, food, or indeed any commodity entering into the world's trade does so under what may be called international prices. These prices become the measure of value for skilled products everywhere.

Values may, and do, vary as the cost of transportation from place to place, or from one country to another. For example, ice is cheap at Reno, Nevada, but is dear at Tucson, Arizona; but if carriage is taken from the Tucson price then the Reno price will be the same or nearly the same, the difference being the mercantile profit in buying, shipping, selling and waste. Sulphur in Iceland is cheap, and is dear in New York, but the difference is only the cost of carriage and the profits of trade. The general or international price is the same; so it is all over the world where commerce extends, there is an international or general price that determines values.

This proposition is not presented as a theory, but as an axiom based on facts observable by everyone, and in respect to all commodities that enter into the word's trade, and even of all commodities independent of the world's trade if we include local imposts or taxes that enhance their value. If the reader will admit this commercial determination of prices, which, reasonably cannot be questioned, then there will be laid down the foundation on which must rest a "law of wages," that is, we will have a measure for what wages produce.

The next proposition or fact in respect to manufactures is that the product consists of three elements; material, labor, expense and profit. If there was any doubt in regard to the preceding proposition respecting values there will certainly be none in the present one, which is shown by any set of account books that can be referred to. All estimates are made out in this way; these four elements are treated in separate accounts to make up manufacturing cost, and the aggregate of these four elements must not exceed the general value of the commodity produced. If it does the manufacture must fail. This is evident, because the capital would disappear in losses.

The labor element is sometimes the principal one, sometimes the second in amount, but rarely less than one-third of the whole. In our industries here, in San Francisco, it is approximately the same as material, or, on an average, about two-fifths of the prime cost of commodities. Now material may fluctuate in value, so may, to some extent, expenses and profits, also wages, but the "aggregate" of the four elements named must not exceed what the commodities produced can be furnished for elsewhere; otherwise the industry must cease. No one buys goods by sentiment or on patriotic grounds, any more than workmen take low wages on such grounds, and whenever the San Francisco price exceeds that of other places, manufactures might as well cease at once, because their end is determined. Among these elements of cost, labor is the most flexible—the most at control. Material does not vary widely or rapidly in one place, while expenses and profits remain almost fixed, and as there must be a balance between the whole, there is a constant tendency to vary wages.

Prices may be and are higher here for various reasons, such as local guarantee of quality, facilities for repairs in many cases, and especially in a better adaptation of what is produced. Time also in some cases modifies work, and very frequently the quality of work, especially where strength is a requisite, or important. Patented inventions also affect trade and prices to some extent, but, as before claimed, all these things are local and beyond them is the "world's price," which, in the end, determines standard prices with the reservations before named.

Now it is apparent in such a system that wages must be a fixed quantity all over the country, or, as we may say, all over the world, in respect to staple, skilled products, and cannot be raised except by taking a corresponding amount from material, expense or profit, or, as is sometimes the case, by "eating up" the industry.

THE RATE OF WAGES.

In these remarks the "amount" of wages is what is dealt with not the "rate." That is a different matter governed by other laws, and contingent upon what men produce. For example, a boiler maker might be dear at $2.00 per day, another one cheap at $4.00 per day. The books of a boiler makers' works do not deal with "day's works" directly, but with the "amount" of wages entering into any new work. The same rule holds in all industries, except when the "time" of men is contracted for in repair or special work, and even then the time is only a method of arriving at the "amount" of wages. This is another thing of which little or no information is given in the literature of labor, and is a matter workmen must understand before we can look for either intelligent or reasonable action on their part; that is, "time-work." Wages based on time is an anomaly at best. It is a system made necessary in many kinds of labor, but none the less illogical and difficult. It can not be changed in any but settled uniform industries, but it can be explained. When workmen are free to go from place to place, or from country to country, the amount of wages must be nearly uniform, and must indeed be so for the reasons that have been explained, but the "rate" will vary with proficiency or skill. Here, in California, wages vary as two to one in some cases, depending on proficiency, but the unions take no account of anything but "time," and in many cases compel this measure or system. A man's time is worth nothing. It is only what he performs that he can be paid for, and as a rule the more proficient the workmen are, and the higher the wages in proportion, and the more profit there is on their labor.

We are well aware of the sophistical cloud thrown around the subject of values, prices, wages, and other economical elements, and believe that there are really no mysteries in the case that cannot be solved by the rules of business and accounts. For example, there have been many learned essays written by eminent men to determine "what capital is." This abstruse problem, which had bothered the economists for a century, was settled by a single suggestion in a single sentence, by a Californian. He said, "look into a ledger and see what is set down to capital account there." That was the end of the problem, because the question really was what should be written in a capital account. The thing called capital had been displayed since the Venetians invented book keeping, but no one thought of looking at the real thing itself. The ideal was more attractive, and afforded wider scope for disputation and speculation.

It is just the same with the labor and wages problem, common account books contain the basis of all the economic problems involved, and what they lack is all around us in examples and facts. For illustration, account books will show all over the world, the labor cost per ton of making shaped iron and steel; of producing cotton and other cloths; of raising a ton of wheat, or grinding a ton of flour; the cost of making boots and shoes, hats, plows, steam boilers, wagons and steam-ships. The whole is written up ready for use, but it may be doubted if there is in any of the unions in this country the slightest information on this subject.

WATER FRONTS AND HARBORS.

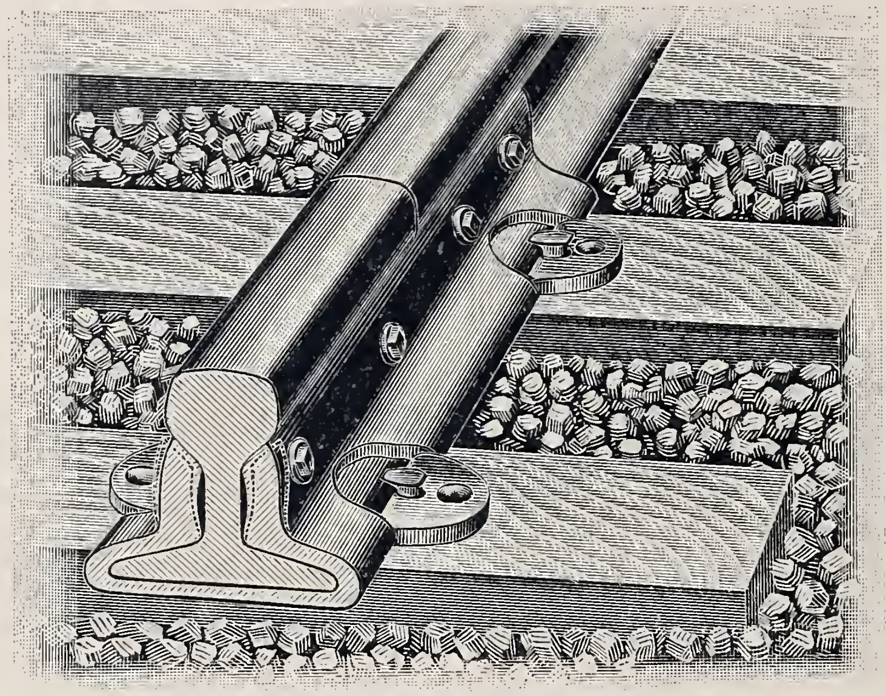
The River Tyne, on which is situated the city of Newcastle and Gateshead, in England, has had sixty millions of cubic yards dredged out of it during fifty years past. The river was made, so to speak, and is really a canal with great piers or dams built out into the North Sea at the mouth, to secure a passage across the bar. There are great docks for refuge at the mouth of the river equal to 79 acres of area. The amount of money spent on the river is $50,000,000.

The Clyde, at Glasgow, Scotland, is another work, greater than that of the Tyne. This river, to begin with, was not even as large as the Tyne, but is now a magnificent ship canal. Now Manchester is following, without even a river as a base, to cut a canal to tide water. These three improvements, that will cost hundreds of millions, are built by private enterprise, and with paid in private capital.

Antwerp, in Belgium, a city of 100,000 in 1859, and 200,000 in 1884, spent during the thirty-five years intervening $600,000 a year on the water front and river, or a total of $15,000,000. The government, at the same time, spent $8,000,000 on the other side of the river. The Dutch have cut a great canal from Amsterdam to the North Sea.

Captain F. A. Mahan, an officer of the U. S. Army Engineer Corps, gave certain statistics in a recent lecture of his before the Franklin Institute, on "Philadelphia as a sea port," that must have made our friends of the Quaker City ashamed of themselves. Considering the circumstances and demands of that port, it is the most neglected one in the world for a city of the size.

What the future is to bring forth in works of this kind, for American cities, is a problem. Captain Mahan says that New York alone, has adopted a systematic procedure in the improvement of her harbor and water front, and doubts if the prosecution of the work will keep pace with the city's growth. It is a problem of dealing with the future ; a matter which no one at this day seems to have much concern. The older works, before mentioned, have returned in dues and tolls from 50 to 60 per cent. of their cost, and in twenty-five years more will, no doubt, return it all, but our people do not trouble themselves with schemes that involve 75 years to complete, and it is a great mistake that they do not.



A NEW RAILROAD SPLICE.

JOHN COYNE, PITTSBURGH, PA.

The drawing above has been sent by Mr. Coyne for publication with descriptive matter, in substance as follows:

The engraving shows one of his improved splices for railway bars, that has the following functions. To impart continuous rigidity through the coupled joint, sustain the rail in all directions vertically, laterally and longitudinally, amounting, in fact, to the same thing as a continuous section where the rails are joined. It is also claimed that the clamping nuts do not work off, because not disturbed by flexure, and this alone is a feature of much importance.

The device, as will be seen, consists of a sheath into which the ends of the rails fit, its sections being made with respect to strains, and the main flanges bolted in the usual manner. Clips or lugs are turned out at the sides and flattened down to fit on the sleeper or sills, giving a broad and sufficient area there.

This is a considerable advance in the direction of a "continuous rail," which has been the ideal aimed at by engineers since the beginning, and if there are no impediments of manufacture, or of application, it is likely that Mr. Coyne's invention will meet with a wide use.

A TAX ON LAND VALUES.

"A prophet is without honor save in his own country," is a proverb that needs no proof. It is exemplified in the case of nearly all eminent men this country has produced, among that class called "thinking." Motley, in history; Draper, in philosophy, and Whitney, in philology, are without honor in their own country compared to what has been accorded to them by other nations, and the same thing is true of almost any one who has risen to rank in any department of knowledge that has not a specific or local application.

One of the most remarkable cases of our day is that of Henry George, who has been claimed to be the most distinguished living American, but who is not only without honor due in his own country, but is disparagingly spoken of by, perhaps, a majority of his countrymen. The main reason of this is that he, like all other eminent thinkers of his class, despises "tact," and uses no art to meet prejudice. His *Progress and Poverty*, one of the remarkable books of our time, has, at home, met with no criticism that seems relevant, or that is fair, because such criticism has nearly all of it been directed to the closing chapters under the head of "a remedy," in which he suggests that taxes should be drawn from rent, or from land values. This seems to be the only portion of his work read or understood in this country, a portion that is regarded as subordinate in other countries, and it is no unfair criticism to say that most writing and reviews directed against the book are merely "begging the question," because the main part of the work is complete without this portion, so much assailed.

In proof of this, we defy any one to show where the first and main chapter of his book on wages and capital has been fairly discussed, or where his treatment of the Malthusian theory has been controverted. The laws of distribution are passed over, and the point of attack is "a tax on land values."

What the merit, justice or practicability of this portion of the book may be, we do not know, and do not care. It is the practical portion, respecting which opinions may be expected to differ. The gist of his work ends in its fifth section, out of ten, and it is on the first five that are foundedthe reputation of Henry George—the gauge which shall in the future determine his place among American thinkers.

That portion of his work devoted to taxation of land values, and which people consider so revolutionary, would have been differently received if it had been commonly known that the great city of Philadelphia has a system of taxation founded on the method Henry George recommends, a system found beneficial in every way, and one that will likely never be changed. Taxes there, are assessed on real estate, paid out of rent, and in this manner fall on the whole community. Every one must use land or real estate, and are taxed in proportion to such use, either as owner or tenant.

The effect of this is just the opposite of what people commonly suppose. Instead of raising rents it in fact diminishes them. There is not another large city in America where a mechanic can have a complete house of six to eight rooms, with heating furnace, bath, and all conveniences, and pay the rent out of his wages. In New York, where personal property is taxed, rents are twice as high as in Philadelphia. This method of taxation has attracted attention in other cities, Cleveland, Ohio; Detroit, Mich., and Minneapolis, Minn., among the number, where the same system would, no doubt, have been adopted had it not been for the successful opposition of speculating land owners.

Taxation on land, or land values, is neither revolutionary nor new. It produces an equalization of taxes, and is fair in every way to the active, producing population, but its effect is to prevent holding land for speculative purposes and absorbing an increment earned by others. Mr. Washburn, the owner of extensive flouring mills in Minneapolis, and a man who has done much to build up that progressive city, some years ago, said there were people around him who had acquired greater wealth than he, by holding land about the works he had built up.

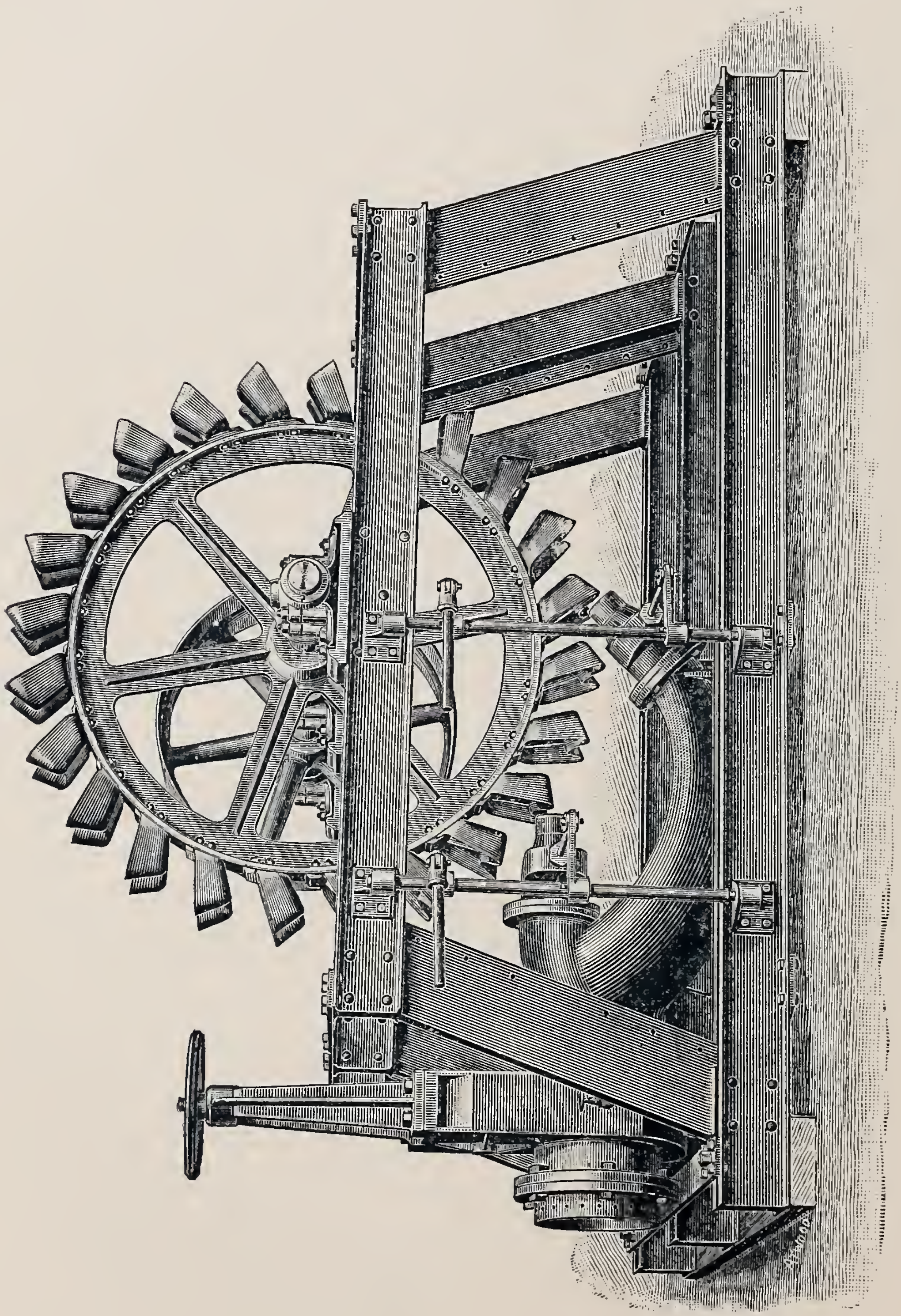
The same thing is true of all cities, and anything to prevent land holding for speculative purposes is for the public good. This, all must admit, but it is not the purpose to argue this matter here. Present indications are that the subject is soon to engross attention everywhere among our best people, who are beginning to inquire if taxes should be assessed on the tools, implements and agencies of industrial production, or on any kind of property which causes one man to pay the taxes of another.

In New Zealand, where one would look least for a reform of the kind, a considerable advance has been made in a direction of a tax on land alone. During last year acts were passed by the government there, which have already given signs of great advantage. The chief officer of the colony in a recent statement says:

"There is more employment than formerly, and I think our land policy has a great deal to do with the returning of the people to these shores. Everything depends on the land policy, and our policy in dealing with the land, and the liberal views generally expressed, are having a considerable influence in bringing the people back. We have received much of commendation in Australia, especially among the popular papers, circulating directly amongst the people. * * * Capital will not leave the colony. Capital was never more plentiful than now for investment, and interest has not gone up."

This new land taxation policy of New Zealand is, no doubt, due to the visit there some years ago of Henry George, who lectured in that country and explained his views, at any rate the policy pursued is on the lines he recommends.

On the return of Henry George from Europe, five or six years ago, he was entertained at a banquet in New York, which embraced a personelle, which for intellect has never been excelled in this country by equal numbers. This claim we make on the opinion of an authority by no means partial to his views, and have no doubt of its truth. His participation in municipal politics, and his many acts that show a want of the tact common to business people, have nothing to do with a philosophy that once given out has ceased to deal with persons, and is to be tried only by the gauge of truth. Our attention was called to his writing by two contemporary reviews, one claiming that his book was an argument for socialism, and the other that the same book was a powerful argument "against" socialism; since which time it has been a custom to attach but little importance to reviews and opinions of economic writers.



TANGENTIAL WATER WHEEL.—UNION IRON WORKS, SAN FRANCISCO.

TANGENTIAL WATER WHEEL TEST.

The Union Iron Works send the following results of some tests made with one of Dodd's Patent Tangential Water Wheels at Amador City, California, by Mr. E. T. Hale, of the Keystone Consolidated Mining Company; also an engraving of the wheel shown opposite. The communication is as follows:

"We have tested the 4′ double-nozzle wheel you furnished this Company for driving an air compressor, in the following manner and with the following results:

The compressor is a Duplex Double-Acting Richmond patent, with cylinders 16″ diameter, 20″ stroke, designed to make fifty (50) revolutions per minute.

In order to find the friction, or amount of power required to drive the compressor empty, a Babbitt nozzle tip was made of the proper size to deliver sufficient water to the wheel to drive the compressor up to its speed, viz., fifty revolutions. The water discharged was carefully measured and found to be twenty-one (21) miners' inches (*Amador Canal measurement, equal to 1.4 cubic feet per minute*), or 29.4 cubic feet per minute to drive the compressor empty. The pressure gauge showed 120 lbs. as running pressure, equal to 276½ feet effective head.

The Babbitt nozzle was then removed, and the two small nozzle tips (1.3″) were put on. With these two tips the result was as follows:

TEST I.

Gauge Pressure—120 lbs.
Water discharged—86 miners' inches, or 120.4 cubic feet per minute.
Revolutions of compressor—50 per minute.
Receiver pressure maintained—35 lbs.

TEST II.

These nozzle tips were then removed, and the large ones (1.67″) put on. The result was as follows:
Gauge pressure—120 lbs.
Water discharged—140 miners' inches, or 196 cubic feet per minute.
Revolutions of compressor—51 per minute.
Receiver pressure maintained—78 lbs.

The percentage of useful effect developed by the wheel we have determined in the following manner, and we should be pleased to have you submit the results obtained to one or more competent hydraulic engineers for verification.

FRICTION.

$\frac{29.4 \times 62.3 \times 276\frac{1}{2}}{33,000}$ =15.34 H. P. as the theoretical energy contained in the water.

As the nozzle was very small in proportion to the size of the buckets, we assume that the wheel did not develop more than 75 per cent of useful effect. This assumption is based upon experiments with nozzles made at the University. This would give us $15.34 \times .75 = 11.5$ H. P. as the actual power consumed by friction.

TEST I.

$\frac{120.4 \times 62.3 \times 276\frac{1}{2}}{33,000}$ =63 H. P., or total amount of energy contained in the water used.

$\frac{201 \times 22.88 \times 6.66 \times 50}{33,000}$ =46.4 H. P., or amount of power required to compress the air under 35 lbs. receiver pressure.

We then have—$46.4 + 11.5 = 57.9$ H. P. as the actual power developed by the wheel.

Then $57.9 \div 63 = 91.9$ per cent. efficiency.

TEST II.

$\frac{196 \times 62.3 \times 276\frac{1}{2}}{33,000}$ = 102.3 H. P., or total amount of energy contained in the water used.

$\frac{201 \times 37.5 \times 6.66 \times 51}{33,000}$ =77.57 H. P. or amount of power required to compress the air under 78 lbs. receiver pressure.

We then have—$77.57 + 11.5 = 89.07$ H. P., as the actual power developed by the wheel.

Then—$89.07 \div 102.3 = 87.6$ per cent. efficiency.

If our method of determining the efficiency of the wheel is correct, we believe you have set the mark a few notches higher than has been reached heretofore. At any rate we are more than pleased and satisfied with the wheel.

Yours very truly,

(Signed.) E. T. HALE,

Supt. of the Keystone Consolidated Mining Co.

As Mr. Hale invites criticism, it may be pointed out that the measured amount of water does not agree with the discharge of two nozzles of 1.3 inches bore, and as "nozzle discharge" is a tolerable accurate measure for volume, there may have been some error in measurement. The phenomenal efficiency shown led us to submit the data to a well-known engineer who sends the following reply :

"It is difficult from the incomplete data furnished to form any reliable idea of their value. One point, however, stands out prominently and leads to doubt of the results given.

The friction of the air compressor, which, by the way, if correctly ascertained is excessive, should not be taken as a constant quantity, as has been incorrectly done in this case. The friction must increase with the work, though not in proportion to the work.

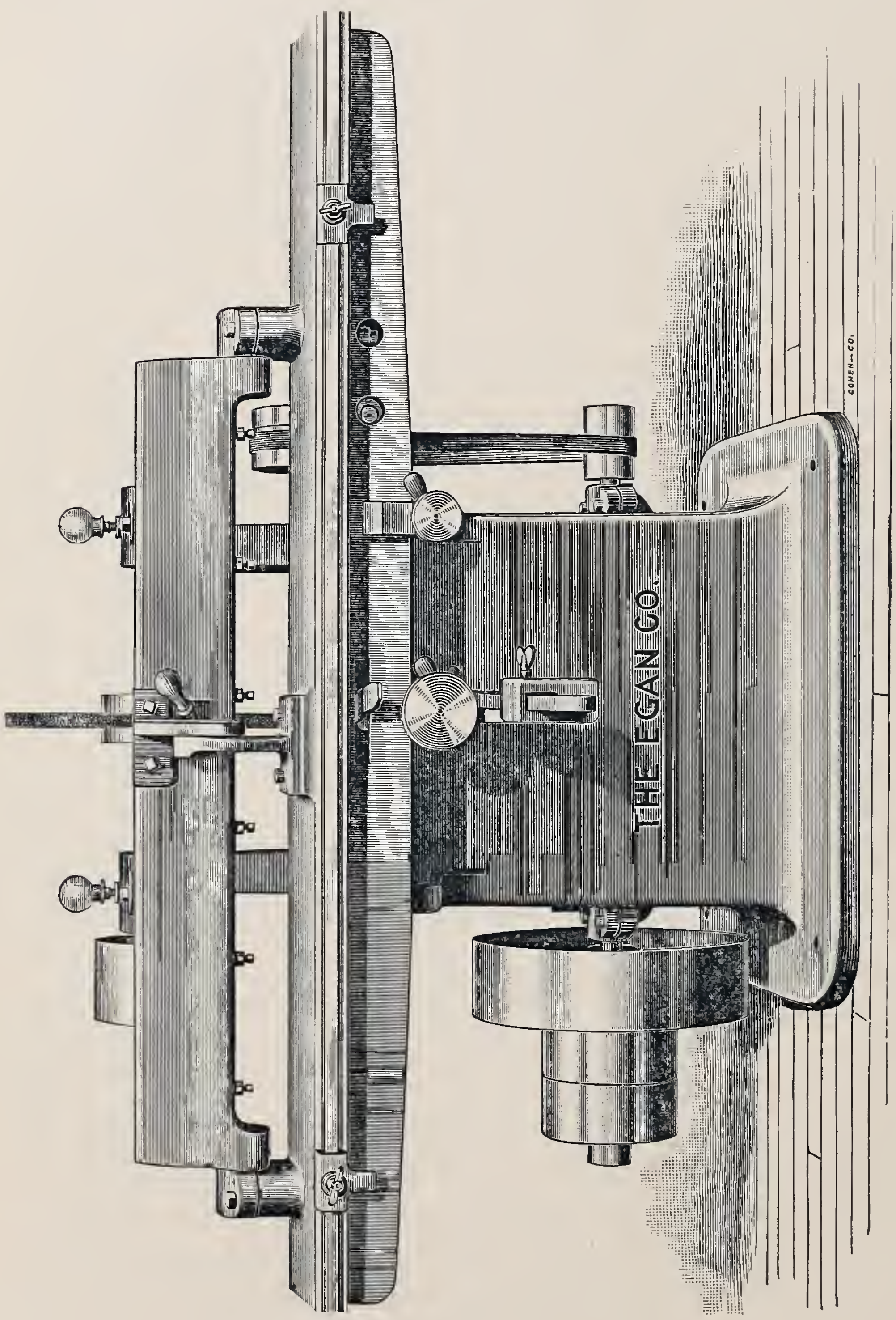
The only way to arrive at the work done by such a wheel is by a friction brake test, and this should be made by experienced persons. In this case we are not informed of the "method;" results only are given. Under these circumstances Mr. Hale's request to have other engineers examine his method of making tests can not well be complied with."

CIRCULAR SAW GUARDS.

Mr. C. E. Grandy, writing in the *Mechanical News* in respect to saw benches, or "bench saws," as he calls them, which is a much better name, says the fence or gauge for circular saws should be as long as the diameter of the saw and not extend beyond the middle of the saw.

Mr. Grandy is right by all rules of experience, theory and common sense, but he is wasting time in trying to instruct people in this matter. Nearly all bench saws are made with a long fence extending back past the saws, in a manner that is stupid and dangerous, but so it has been from the beginning. How such an arrangement of a saw guard first came about is hard to conceive. Whether they were ever so made in other countries we do not know, but one thing is certain, that no one will, at this day, find anywhere but in this country, saw guards extending back past the saws.

Our reason for this, and the only one we can think of, is that bench saws in this country are hardly ever employed for any other purpose than sawing boards or dry timber after it has been prepared at the mill. Our timber system of sawing it green to finished dimensions, or attempting to do so, does away with what may be called bench sawing for any except dry material, and of small size, so that it is possible to jam pieces through with a fence the whole length of a bench, or several times the length it should be, but large or green material can not be sawn in that manner, nor any material be sawn true.



PLANING-KNIFE GRINDING MACHINE.—THE EGAN CO., CINCINNATI, OHIO.

PLANING-KNIFE GRINDING MACHINE.

THE EGAN CO.—CINCINNATI, OHIO.

It is not very long ago when the makers of wood-working machinery made no pretense of following what may be called the best practice in machine construction. They made iron machine frames much in imitation of the wooden ones that had preceded, and to carry out the "carpenter idea" ornamented their work with beads, mouldings, and filagree castings. Finally, to finish off, still in the carpenter line, they put on a good coat of varnish, so that every pin hole and "swell" in the casting would stand out in bold relief. Every ounce of iron that could be spared from minimum strength and ornament was pared off the patterns, so the machines when done resembled ornamented "skeletons."

Now, all this is changed, and we have not seen a better example of the new practice than is afforded by the machine above, made by the Egan Co., of Cincinnati, Ohio. It is for grinding automatically, planing machine and other knives that have to be straight and accurate, and before mentioning its functions, we wish to call attention to the general design.

It will be seen that there is no ornament whatever, except symmetry, which generally means material in the right place. The amount of metal is perhaps three times what would have been used twenty years ago in designing a similar machine, but is no more than is required to secure good performance of a high-speed emery wheel in connection with accurate gauge grinding. The trunk comes down in a substantial manner, and turns out to form a face on the floor, like nature frames trees. All the lines possible are made straight, and the corners trimmed off all over, except on working faces.

The knife to be ground is mounted in the strong pivoted clamp at the top, and is traversed with the heavy table on which it stands, by means of a screw beneath, protected from the grit. The reversing motion is automatic, operated for the right or left by the tappets seen in front, so that when a knife is put in, the operation of grinding goes on automatically, except setting up toward the wheel as the metal is cut away. It is a machine that reflects credit on the company as an example of plain symmetrical design and complete adaptation.

THE MERCANTILE THEORY OF MONEY.

The old mercantile theory of commerce, better known as the "balance of trade" was, so far as most people are concerned, buried a hundred years ago, at the same time with witchcraft, the signs of the zodiac, and some kindred delusions. It was never better explained than in a newspaper article recently, by an illustration of this kind:

Suppose an American merchant sends to Europe a cargo of some kind worth $100,000, and sells it there so as to buy of other goods $125,000 worth; then the balance of trade theory would stand thus: exports $100,000 imports $125,000, balance of trade against us $25,000.

Suppose again, the same merchant sends another cargo of like value, and on the return voyage the ship is lost with all her cargo. Then the balance of trade account would show, exports $100,000, imports nothing; balance of trade in our favor $100,000.

Now this may seem very silly, but one need not go far to find it set forth as a sound principle of economics. This very thing has had place and presentation in public articles by prominent men within a year past.

The old theory was that such balances were paid in coin, and that this took gold and silver out of the country, and as there was no understanding of wealth it was assumed that coin alone was wealth. It was a childish opinion or theory which Adam Smith explained with all its absurdities, a hundred years ago, in the *Wealth of Nations*, but it lingers yet, just as a belief in witchcraft, the influence of the moon and other delusions of the kind, but more commonly.

The popular conception respecting money is, that it alone constitutes wealth. It is the most condensed form of it, because with only a few exceptions no other metals or substances are so valuable as gold and silver. Only precious stones are more valuable than gold, and several metals are more valuable than silver, but they are not employed for circulation or coined, because not otherwise suitable for that purpose.

A metal for coin must have certain qualities, among which the principal ones are, that it must be easily divisible into small pieces;

must be capable of being reunited again without loss; must be soft enough to receive the impress of coining dies, and above all it must be non-corrosive so as to endure.

Gold and silver have these qualities, moreover are useful and desirable in the arts, and are scarce, costing as much as their money value to procure them. They are therefore used as *money*, but as "*wealth*" they are no better than iron, steel, lead, sawn timber. Some of our richest men may have little or no gold or silver, in fact they have little use for them, not so much indeed as a poor man, because their accounts are paid by checks.

The mercantile theory rests on the assumption that money alone is wealth, and in trading one nation must lose what another gains, also that there is an antagonism between peoples and countries in all commercial matters. It does not recognize the central fact that "what we buy, is pay for what we sell" and that buying is just as profitable as selling, if we buy at fair prices.

The money jumble that grew out of the mercantile theory, or system, is what lies at the bottom of all the "moneyisms" of our day, such as the greenback doctrine, legal tender, silver question, and the rest. They are all traceable to this one generic root of ascribing to gold and silver a peculiar kind of value because they are employed as a medium of exchange and stamped by the government to declare their weight and worth.

The only way out of all these problems, and the one finally reached by any one who without prejudice will follow it to a conclusion, is that gold and silver are just the same as iron and copper; that they are commodities which are scarce and much desired for ornament and use in the arts, and also of much value for use as money, because of their qualities that have been before pointed out. By this method of reasoning all becomes plain. The sophistrisms of "representative values" disappear and one may go on without doubt or perplexity to a rational understanding of the whole subject.

WATER WHEELS AT NIAGARA.

Messrs. Ganz & Co., of Buda Pesth, have published their plans for turbines and dynamos at Niagara Falls, and of course thereby invited comment, of which we will contribute a little.

Messrs. Ganz & Co. propose pressure turbines of the Jonval type. These were chosen no doubt, because of the smaller dimensions compared with either Fourneyron or inward flow wheels, and this aside from the question of pressure turbines of any kind, is subject to one criticism and one of much importance.

The load on the wheel shafts, including their own weight, armatures 16 feet in diameter, and the weight of the water on the vanes is estimated at 125 tons for each wheel of 5,000 horse power. What portion of this is estimated as water pressure we do not know, but roughly this pressure inverted, that is, arranged to press upward instead of downward, usually sustains a wheel and a sufficient shaft to convey its power to the top of the water head, and this is the subject of one criticism we venture to make.

Messrs. Ganz & Co. propose collars on the shafts, having a considerable width of face, moving of course, at varying degrees of velocity, an oil supply for these collars is to be forced in by a pump, and in addition to this, below all, under the end of the shaft in the tail race, a hydraulic piston fed by other pumps. This seems to be the most important part of the scheme, occupying a prominent place in a description of the plant, published in *Engineering*, London, of Feb. 19th last.

Here in California when centrifugal pumps are set in pits from 50 to 100 feet deep and driven by shafts extending down from the surface, the weight of the shafts and their mountings, is supported by inverting the water pressure, the whole being put into equilibrium as soon as the pumps are started.

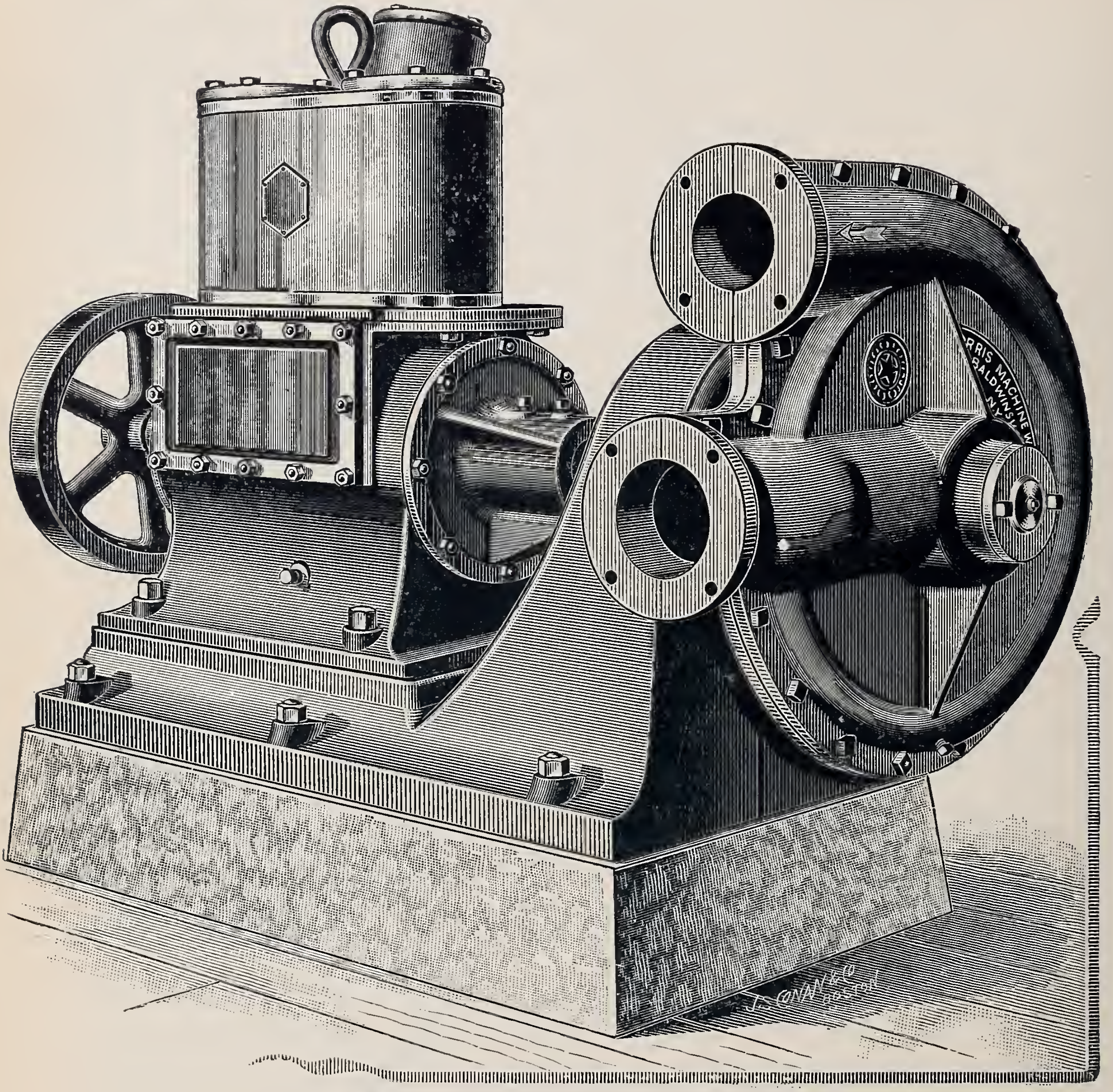
What impediments there may be in feeding a Jonval turbine upward, one cannot foresee without preparing plans, but there seems to be nothing in the way, except some additional room and expense, while the result would alter the whole scheme as presented by Messrs. Ganz & Co., and convert a questionable mechanical scheme into a sound practical one in so far as endurance.

If the water pressure on the wheels in the plans proposed is 50 tons, by inverting this, there is not only 50 tons removed from the vertical load, but there is an upward thrust of 50 tons, thus changing the total from 125 tons to 25 tons, which could be taken up without hydraulic and oil pumps, or any of the special contrivances in Messrs. Ganz & Co's plans.

Reasoning *a priori* in the matter leads to a very different plant altogether. When 5,000 horse power of work is to be conveyed upward 130 feet, the circumstances point to something else than shafts 16 inches in diameter running at 125 revolutions per minute. The maximum movement of the "material of transmission" would be only about 575 feet per minute. This for economical transmission could be multiplied by ten and raised to 5,000 feet per minute; but supposing that heavy shafts at slow speed are to be employed, there is certainly some better means of sustaining than collars lubricated by force pump and hydraulic steps fed from an accumulator.

To further criticise the scheme and supposing the weight to be carried on radial faces or collars, the practice at Lowell, Mass., for example, is certainly better. The collars are made shallow in depth and increased in number until there is an approximation of uniform velocity between the bearing surfaces, oiling is easily and perfectly accomplished by "feeding at the center" depending on centrifugal force to carry the oil outward by the aid of proper grooves in the faces, or even without grooves, if the surfaces are not loaded beyond a fair limit.

The whole plan in this regard calls to mind the centrifugal pumping plants on the Nile in Egypt, made in France. The great point and difficulty was in sustaining the running parts, which would have sustained themselves with a slight change in the pump wheels. Messrs. Ganz & Co. who are undoubtedly a foremost engineering firm of our time, can do well in studying the experiments on hydraulic foot steps made by Professor Hesse, of the State University of California, about five years ago.



CENTRIFUGAL PUMP AND ENGINE.

THE WESTINGHOUSE MACHINE COMPANY, PITTSBURGH, PA.

The engraving above, which is an exceptionally fine one, shows a standard Westinghouse engine directly connected with a centrifugal pump, or, in other words, a steam centrifugal pump compactly arranged, with its driving power and all parts on a short bed plate, the whole self contained and convenient.

The pump presents an unusual appearance with the discharge and suction pipes in one plane, or parallel, but this is, no doubt, an adaptation to some special use or purpose.

The main part is the design, which is typical of the advanced practice of our day. The sole plate or main frame is massive, without ornament, and disposed in pleasing lines. The Westinghouse engines are especially suitable for connecting direct to centrifugal pumps, and, as may be seen, are extremely compact, and otherwise falling naturally into place for the purposes.

The efficiency of a pumping machine of this kind is far beyond what is attained by common, reciprocating pumps when a large amount of water is to be raised, besides there is no difficulty in pumping water containing gravel, tan bark or other solid matter that will pass through the pump wheels.

ON WHALEBACKS.

We have several times on general principles, and without entering upon the subject of naval architecture, pointed out the absurdity of the claims made on behalf of the steam barges called "whalebacks" knowing that the time would come, sooner or later, that would prove that the evolution of the ship building art, like others that have come down through ages, is not to be "upset" by the discoveries of one man or all at once radically changed, by any number of men. It now seems that the contour of the whaleback barges is such as to present a tolerably flat surface to the seas "bows on," as the sailors say, and consequently are knocked in.

We have heard an old navigator say, that the decks of a ship is her vulnerable part, and that a sea would go through any structure that presented a surface normal to the action of the waves. Anyone who has had experience in storms such as occur in the north Atlantic, well knows that the fore foot of a whaleback, or any vessel with such lines, would be crushed like a box of pasteboard.

Loaded down like a monitor, with little or no free board, and everything housed, a "whaleback" would no doubt weather out the storms of the lakes, or in most cases of coast service, where the disturbed strata is shallow, but when it comes to being "struck", at an upward angle forward, the whole spoon-shaped end of a whaleback would be crushed or doubled in, the same as the decks of a common steamer would be if she fell off into the trough of the sea and presented surfaces normal to the force of the waves.

The steam barges may to some extent develop new and useful features; it is but natural that they should do so, but the sweeping claims for them, set up by some of our Eastern friends, are inconsistent and unsupported by experience, on this Coast at least.

THE BUREAU OF AMERICAN REPUBLICS.

If this bureau is an outcome of the Pan-American Congress, and an only outcome, it may justify the time and labor spent in that somewhat ideal convention. The bureau has already published more than thirty bulletins, relating to the various countries of South and Central America, their laws and internal regulations, also descriptions of the countries.

The one now before us, relating to Costa Rica, is a sumptuous production in respect to paper, type, plates and general dress, no other government printing we have seen compares to it. This fact will lend no little to the attainment of the main objects in view, because other nations, France, England and Germany, spare no pains in the trade literature sent into the Spanish American countries. There is given at the end of the book a complete list of import duties, which are reasonably low and apparently uniform. There is also a mercantile directory of all the principal banks and mercantile houses, wholesale and retail, in all the principal cities and towns, which will be of much value to any one traveling to that country. The present bulletin opens with the following account of Costa Rica, which we think of enough value, even in the abstract, to be reprinted for our readers.

"The territory now known as the Republic of Costa Rica was discovered by Columbus on the 5th of October, 1502. It was called *La Costa Rica* (the rich coast) on account of the quantity of gold the Spaniards found there. If this name of the Republic should need in any way to be confirmed, ample justification therefor would certainly be found, not only in the auriferous sands carried by her famous river, called in colonial times *La Estrella*, now Tilorio, or Changuinola, and in the wealth of her mines, especially those of the Aguacate Mountains, which according to the expression of a distinguished writer, might more properly be called Gold Mountains (*Montes de oro*), but also in the wealth of her soil and her forests, and in the singularly privileged position she occupies in the central part of the American hemisphere, facing both oceans and bordering, more or less actually or directly upon the great interoceanic canal to be opened either through Panama or Nicaragua, or both, which will cause the commerce of the world to pass by Costa Rica and pay her tribute.

The learned Costa Rican writer, Señor Don Joaquin Bernardo Calvo, from whose valuable works a considerable part of the information contained in this hand book is derived, has taken pains to ascertain the exact date in which the name of his country begins to appear in official records. He speaks of a report of certain expeditions under the command of Martin Estete, who in 1529 explored the San Juan River, then called El Desaguadero (the outlet), and also of a real cédula (royal ordnance) dated May 14, 1541, where the name of Costa Rica appears as officially given to that section of the New World.

In colonial times Costa Rica was a province of what was called the Kingdom of Guatemala. But the uprising of that country against Spain, and the proclamation of its independence on the 15th of September, 1821, secured for her an autonomic government. On the 22nd of November, 1824, she became a State of the United Provinces of Central America (Las Provincias Unidas de Centro-América): but upon the dissolution of that confederacy she assumed her own sovereignty (August 30, 1848,) and has been ever since an independent republic.

The time seems to be rapidly approaching when Costa Rica, because of the homogeneous and progressive character of her population, will be called to enjoy the glorious days which Bolivar predicted. ' Her magnificent position,' as he said, ' between the two oceans may make her in time the emporium of the universe.'' The inter-oceanic canal, whether on the north or south of her territory, or on both sides, while shortening the distances of the world and rendering the commercial ties between Europe, Asia and America closer and stronger, will attract to her territory the wealth and the enterprise of all parts of the globe. ' Perhaps,' Bolivar added, ' the future capital of the earth will be established there, and hold that very station which Constantine wanted for Byzantium when he established in it the seat of the empire.'

The fact may be mentioned here that as far back as 1830 the name of Costa Rica appears prominently connected with the work of an interoceanic canal across the Isthmus of Nicaragua. As shown by an appendix to Report No. 145, House of Representatives Thirtieth Congress, second session, the government of the Central American Republic granted a Dutch company (December 18, 1830) a concession to open the said canal, and pledged itself and the governors of the provinces of Nicaragua and Costa Rica to aid as far as practicable the execution of the work.

Five years before, Don Antonio José Cañaz, the diplomatic representative of Central America in Washington, had written to Henry Clay, Secretary of State of the United States, informing him that his Government had resolved to carry the enterprise to success ; that 'a company formed of American citizens of respectability, was ready to undertake the work as soon as a treaty with the United States insuring the coöperation of the latter was signed ; that he was ready to enter into negotiations for the treaty, and that nothing would be more pleasant for Central America than to see the generous people of the United States joining her in the opening of the canal, sharing the glory of the enterprise, and enjoying the great advantages to be derived from it.'

The famous Danish scientist, Andreas Oersted, so well known for his discoveries in natural philosophy and other branches of science, made in 1851 at the request of the Costa Rican Government a survey for a canal through the river Sapoá to the port of Salinas or Bolaños in Costa Rica and suggested some plans which, if carried on, might prove, perhaps, to be of immense advantage to the country."

MACHINE DESIGN.

Professor John E. Sweet, formerly of Cornell University, and whose opinions we consider of much weight, has written to expostulate against our criticisms of last month respecting a "Professor of Machine Designing." His letter is a private one, marked not for publication, but we cannot refrain from printing a portion that bears especially upon the subject above named. He says:

"Professor Smith is one of my students, was once our foreman, is a man of no pretensions, a hard worker, and as truly a gentleman as any young man I ever knew. The title of Professor of Machine Design is a Cornell affair, which has grown out of necessity. There is a great crowd of students; they have to divide up the classes, and instead of having two classes alike, they divide up the work and "machine design" is, perhaps, as good a title as any other for that portion of the work Mr. Smith is trying to carry out.

It is somewhat difficult to get the professor in drawing, or draughting, to understand that *what to draw*, is of as much consequence as *how to draw*, and I do not think the students will pass through Mr. Smith's hands without finding this out, and Mr. Smith finding out whether the student has any aptness for the business he is attempting to fit himself for. I believe the second greatest service a professor can render is sending home students that otherwise would waste their time. * * * * * * * *

Do you not think the young men can be started in the right direction so that the average of the machine designs of twenty years hence will be better than if the question of looks never came in connection with the question of efficiency? Assuming that machine design covers invention, proportion of parts and appearance. Invention cannot be taught, perhaps, and yet so much of invention as an architect uses in designing a new building can be cultivated. If there is any such thing as figuring the strength of parts, some idea as how to proceed can be given, and so far as looks are concerned, at least the good and the bad may be pointed out if no more."

Since receiving the above letter, Professor Smith has written to us from the University of Wisconsin with further explanations respecting the department of "machine design" and his connection therewith, and has given explanations of value to our readers. Some extracts from his letter, with further comment, will be given next month.

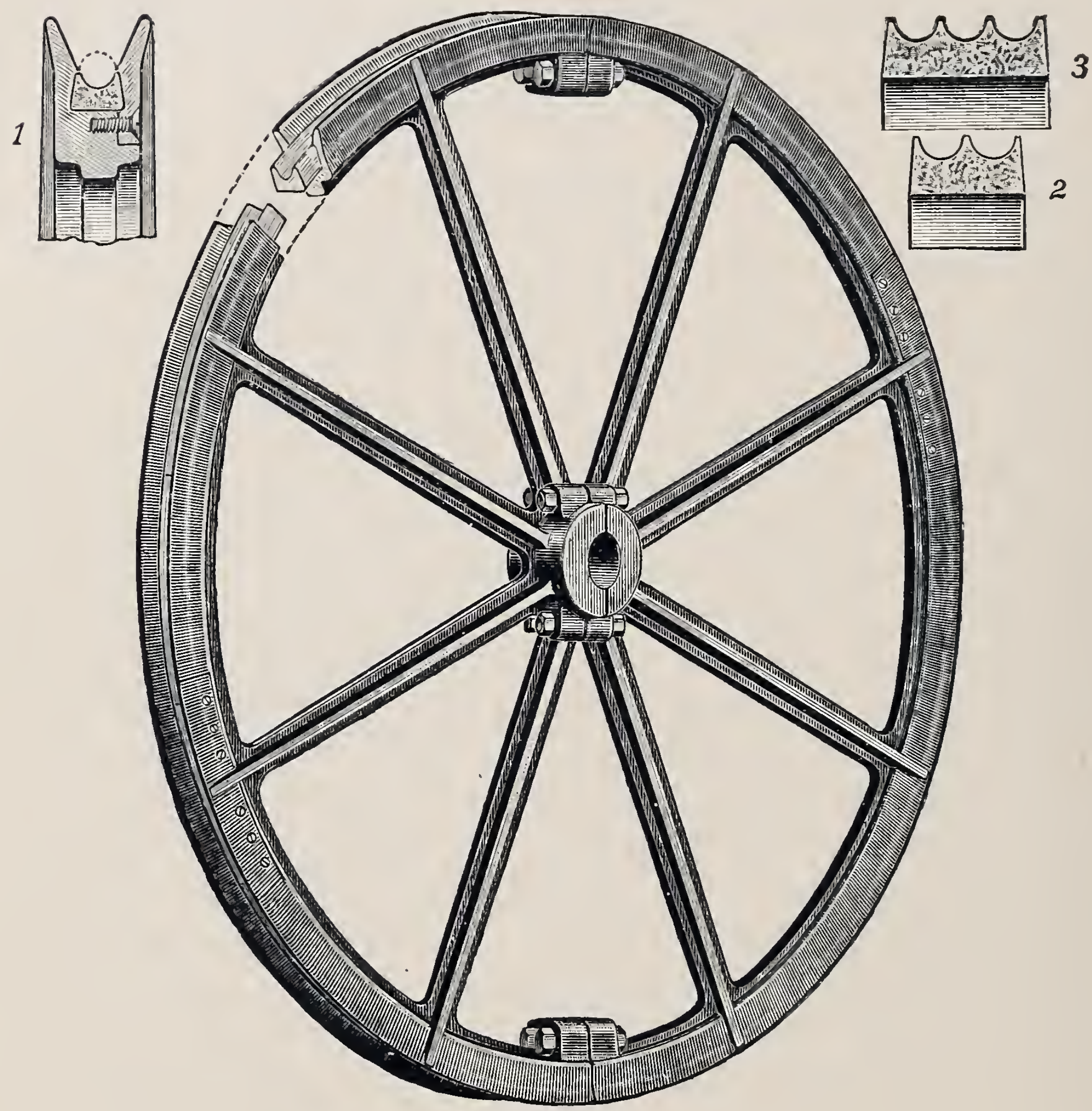
ELECTRICAL STORAGE FOR GENERATING STATIONS.

A correspondent of *Engineering*, London, writes respecting the economy of working large engines for electric light stations, at a maximum load, and the loss entailed by running at half load, or to suit the circumstances of consumption. He shows, as every one must know, that when the load of an engine dependsupon the out put or consumption, not one in ten can work under normal or economical circumstances.

It seems ridiculous to erect, as is commonly done, a steam plant having several times the capacity required at the start and operate it under such conditions, and the argument of the writer above is that such plants should be provided with storage batteries, so the output not consumed, can be accumulated or stored. He also points out the variation in the amount of electricity required in winter and summer, especially in high northern latitudes, and most important of all shows how plants arranged with storage batteries have been very satisfactory and successful.

There is of course nothing new in all this, except that the wastes of the common system are not understood and are not very likely to be, because an equipment for storing adds expense, and its inclusion in country plants would in many cases prevent sales. If this is not a reason, it is hard to see one for the opposition to the accumulator system that exists among electrical manufacturing companies, and why in the case of small plants at least they do not use storage batteries to take up the surplus generating power.

A good deal that is expended for accumulators would be saved in engines and boilers, which need not have the maximum capacity required for consumption, but this again would not be a commercial object to those furnishing plants, so that any change will have to come from those who purchase and use electric plants. The difference in the two cases of operating, with and without storage, is directly analogous to water supply. Operating without electrical storage is the same thing as doing without water storage, and pumping directly into the main pipes without a reservoir, a system never adopted by engineers when avoidable.



BUSWELL'S PATENT ROPE SHEAVES.

WM. F. BUSWELL, SAN FRANCISCO.

The sheaves or pulleys shown in the drawing above, have been furnished to some of the principal cable railway lines here and have the feature of a hard wearing surface, without much departing from the common section and proportions for such sheaves. The following from Mr. Buswell's patent specification will explain the nature and objects of the system :

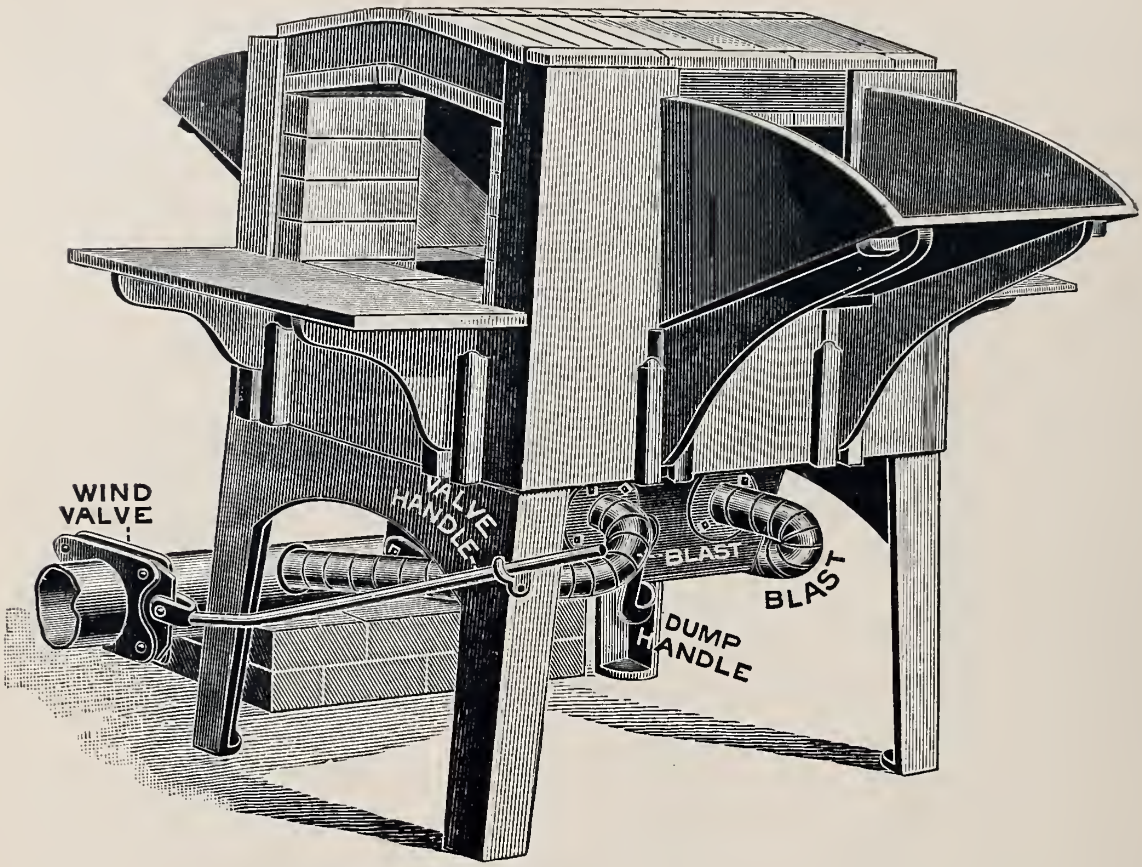
"My invention relates to pulleys or sheaves, especially such as are employed for wire rope under heavy strain, as in the case of traction cables for street railways or in transmitting power by means of wire ropes or cables, and consists in constructing such pulleys or sheaves with a series of inserted segments, forming the bottom or wearing part of the groove or grooves in which the cables bear ; the segments being of chilled iron, steel, or other hard material, and so inserted and held as to be removed or replaced in whole or in part without disturbing the pulley or sheaves, and while the rope is in, place.

The object of my invention is twofold, mainly to avoid wear of the main parts of the sheaves or pulleys by inserting the portions embraced by the cable and subject to abrasion and wear, also to some extent obviate wear of the cables or ropes which occurs when they bear on soft iron that retains sand or grit."

Mr. Buswell informs us that with carefully made patterns the hard segments, made of chilled cast iron, steel, grey iron, or other hard material, can be inserted in a very complete manner, and the rim, when filled and closed by the side plates is, of course, safe from any accident or derangement such as may happen to built up wheels or sheaves. The hard sections can be removed or replaced while the wheel is in position, and without removing the ropes, by taking off the side plates, which are a little longer than the inserted sections.

In the details shown in Fig. 1 is a section of the rims for a single rope. Figs. 2 and 3 show sections of the inserted sections for a number of ropes or wraps, the construction of the sheaves being otherwise the same as for a single rope.

One would scarce expect that in the development of cable or rope gearing, any difficulty would arise in so simple a thing as sheaves or pulleys, but their wear when exposed to grit and dust, has called for a good deal of search and experiment to keep down the expense of maintenance, such experiment has been in the direction of hard material. In the present case this end is attained in the fullest manner, because the chilled sections being cast independently can be as hard as metal can be made.



ENCLOSED HEATING FURNACES FOR SMITHWORK.

THE HACKNEY HAMMER CO., CLEVELAND, OHIO.

The above is a good example of furnaces, or forges, as they are called, for smith work, that are a good deal less known and used than they should be, and, it is safe to claim, that whenever two forges are required, one of them should be of the enclosed kind.

The difference between working steel, or any forging in which steel forms a part, in a fire like the above and in an open one, is so great and so much in favor of the enclosed fire that comparison is hardly to be made. With the latter, the work is in sight and yet heated uniformly all around, because of the reverberating top and sides, and heated at a rate and to a degree that is at perfect control.

The forges, above shown, with openings or doors from 8 inches to 25 inches wide, are made for heating a number of pieces at the same time, and especially to accompany the power hammers made by the company, but are adapted in every way for general work. They are durable and cheap, the price being about $3.00 for each inch of width in the opening or door where the work is put in, a forge of 25 inches costing $75 without lining. The fuel used is either coke or anthracite coal, coke preferably, which can be banked up in the hoppers at each side, and fed in as required.

The fire can be so graduated that the heat will not rise above what is required for the work, which can remain in the furnace without injury until wanted. The slower heating is compensated by a number of pieces being heated at once, or in the case of working a special piece, the temperature can be raised to the welding point in a short time.

For tool making and tempering there is no comparison with a common open fire, and we speak from experience in claiming that for general purposes there should be as many enclosed as open fires in any smith shop where miscellaneous work is carried on, and no other fires for duplicate or uniform smith work, such as we call "manufacturing."

AMERICAN BOASTING.

Professor John E. Sweet furnishes, in the *American Machinist* for April 14th, an article under the above head, which may be read with much profit; and is noticed here with a view of adding a word or two not touched upon by the writer, nor in an editorial comment upon the article in the same issue.

Presuming that most of our readers will read Professor Sweet's article, our addition thereto is to call attention to the effect produced upon young engineers and mechanics, who after being trained up in a belief of our national "supremacy" in the arts, then go abroad, as many of them do, and learn the untruth of their teaching. This leads to revulsion of feeling, and the obliteration, in many cases, of faith in such credit as justly belongs to our own country and people.

Another fault of the supremacy idea is that it is a powerful factor in hindering progress. What incentive is there to improve what is already the best? We believe that the greatest of all causes for research, effort and progress is emulation, and there can be no emulation when there is nothing to emulate. There is no possibility of our retaining our place in the world's progress, or even controlling our own industries, except by excelling in them. Laws to prevent competition are a farce, or will prove so in the end. It must come down to a problem of capacity.

The third proposition we will make is in respect to the patriotic phase of the matter. The true patriot is one who has faith in the resources and abilities of his country, and is anxious that it appear with honor and credit among other nations and people ; who is not afraid of anyone, and stands up boldly for truth, a fair field and no favors. The citizen of any country who understands its resources, and their relation to like resources in other countries, is the only one capable of being a true patriot in the true sense of that term, or has the power to do any good with his patriotism. If we fall behind in any art, let it be known as soon as possible, then a remedy is in view but not otherwise.

In one thing we must differ from Prof. Sweet, that is in the comparative amount of national conceit in this country. It is a matter we have studied with some interest, and observed in several countries with the following conclusion, namely, that national conceit is inversely as national capacity, also the smaller a country and the narrower its field the more conceit exists. For example, in great nations skilled in the various arts, England, France and Germany for example, there is not one half the conceit found in smaller countries, like Sweden, Holland, Belgium. The Latin nations, France excepted, are much given to over estimating their powers and resources. Perhaps the strongest example that can be named is the Mongolian people, who have a sublime confidence in their supremacy over all other nations.

Finally it may be noticed that those who preach their country's supremacy in everything consider that, a sufficient contribution to the general good. When it comes to a sacrifice of time, money or effort outside of their own interests they are the first to fail. The credit we enjoy among the nations of the world, and it is certainly a fair measure, is due mainly to men like Prof. Sweet, who are not afraid of the truth, and believe in their country for its own good, instead of the good they may extract from it.

EXTRACTS FROM A NOTE BOOK.

[BY "TECHNO."]

No. XV

SWEDISH OMNIBUSES.——A BUSY KING WHO EARNS HIS SALARY. HORIZONTAL SUNSHINE.——A LONDON STEAMBOAT COMPANY. TIN-POT STEAMERS.

——————It was not the intention to set down in these notes anything of the ordinary routine journal kind, such as one finds in books of travel, but it is hard to avoid the habit. It is true that one is bound to see things through the glasses of his own occupation and estimate them accordingly, but then again there is the opposing fact that one is apt to pride themselves most on that of which they know the least. A common newspaper correspondent is never so happy as when he dips into science and machinery to dish up some ludicrous blunder, so by parity of reasoning a mechanic will want to describe scenery, the morals and manners of people, with other things of which he has made no study. My Uncle is an exception to this in two ways. He is ready to consider almost anything, and has considered almost everything before, so I am proceeding vicariously in a great degree.

In Stockholm we stayed, not "stopped," at the Rydeberg Hotel. Other people, not Swedes, go to the Grand Hotel. We wanted to see Swedes while here, so lodged accordingly, and I find here, next following the hotel note, the following set down from my Uncle.

"Stockholm," said he, "is a center of refined dissipation, or, to be more exact, is a kind of large pleasure garden, open for four months in the summer. There is commerce here of course, and Government machinery of a very effective kind, but the people don't let either of these interfere with their pleasures during summer time. The city has the advantage of being half water, and the water has the advantage of being half fresh and half salt. That stream or current coming through under the great bridge there is fresh, poured out from a score of lakes reaching away back inland a hundred miles or more ; turn around and you are looking at salt water. The "omnibuses" are driven by screws, made of Swedish iron, and are the cheapest, neatest, steam-boats in the world. Look at the reversing gear when you are in one; the single eccentric is thrown to its angle of advance, each way, by a shell between the eccentric and the shaft, the shell having a spiral slot to turn the eccentric, and slides on a feather or spline in the shaft. The end of the sleeve is turned into collars or grooves that mesh into a pinion, and that is all. There is one piece where we use three, and no running joints that wear out. If you have room among your baggage you had better take one of these boats along, they cost here just a little more than the iron is worth by the ton in England or America.

There are parks, museums, palaces, hospitals, theaters, operas, pictures, and punch here. The opera is the finest in Europe, except in Italy. The palace, or Government house, is the largest in Europe. Stockholm is the Paris of the north in respect to pleasure. Some factories here, one machine works of goodly size, but even these and other business seems to be done for amusement.

The King of Norway and Sweden lives over there in that immense building called the Palace, that is has his rooms there and works there. Works, I say, because Oscar II has few subjects, except laborers, that do more work than he, and why not? A rusty king is of no use. This one here will not become oxidized for want of use. To begin with he is the most learned man on a throne in Europe, or in the world for that matter. He is a scientific man, a linguist and scholar, a writer, painter and poet, and knows how hydraulic cement is made. I heard him lecture on the subject one time, and have not the least doubt of his ability to draw up plans for a bridge as well as for a state paper."

——————Some days here has proved the correctness of my Uncle's "facts," and added a great many more, but the time of departure comes, and it has just been decided that we will not go to Cronstadt and St. Petersburg because it is too hot; just think of that at 59–20 North. It is not heat so much as glare. The sun does not get up overhead so as to be shielded with roofs, hats, and umbrellas, but "comes on" horizontally—goes sweeping around the horizon, giving out an intense light and heat too that is insufferable to a stranger. You see, on the streets, hundreds of white and yellow umbrellas, carried with the stick pointing at the sun. They are worn in front, as Sancho Panza did his front shield, and at the back, as he did his other shield, or are pointed to the right or left.

I got out of my uncle another of his lectures by asking how we would travel from here, and where go when we started?

"I want," said he, "to show you, while in this old country, some water service to stop your boasting of American steamboats. A steamboat and steamship are very different things remember. On rivers or inland waters, including even large lakes, you can build a first-class hotel on a vessel, but you can not send such a hotel to sea, so in comparing, here or anywhere, such service you must keep to deep water vessels, or the other kind.

We will go from here down the Baltic in a steamer, not exactly a deep sea steamer, but near it, and, as I think, one of the best you will find in coast service in Europe. I don't know what steamer it will be, but the service all around here is good.

From Copenhagen to Christiana, from Christiana to Malmö and Lübeck. Stockholm to Baltic ports, indeed all around, you will find service that puts the Steam Navigation Company of London to shame. This Company that owns fifty or more steamers going around their own coast and to ports on the German Ocean are tubs in comparison to the steamers owned here. They carry hogs, cattle, sheep and passengers on the main deck, and are suitable for the quadruped part only. From Hamburg to London, for example, they have a way of contracting "to furnish food," well knowing that no one, not even an "old salt," has stomach enough to eat on these steamers. They are worked commercially for gain, and with all possible disregard for passengers. Here it is different, as you have seen this far. It is more like the American service, which is the best in the world inland, and nearly non-existant outland. The whole depends on competition. There is not a company in the world that would not carry passengers on scows and feed them on beans if there was a monopoly of routes. Passengers on the water get decent treatment because Nature owns the highway. There are no franchises granted in the sea.

At the end of the American war, when the Swedes had but few vessels running to London, an English company put some blockade runners into the Gothenburg trade. These steamers were of the "tin-pot" kind, made for one journey across the Atlantic, in the Summer, on the assumption that one load of cotton smuggled out would pay for the boat. These steamers kept on a little too late one year, got their decks cleaned off, including dirt and cattle, and were blown off toward Iceland. One of them, by burning up all her deck hamper for fuel, got to the leeward of the Shetland Islands, a mere chance and an only chance. The owning firm failed, as it ought to have done before. There are not many of these tin-pot steamers around these northern oceans now. All but the very best of them hybernate in the winter.

We often hear remarks condemning English builders for constructing cheap steamers. That is all nonsense, it is the owner who is to blame. We do not blame people for making swords, guns and torpedo boats, the avowed object of which is to kill people, not people who, as in the case of a bad steamer can keep out of her, but those who are marched up by force to be killed by such weapons. It is true the world has produced some men and firms who would not, under any circumstances, build a tin-pot steamer, but that was because by refusing they got more of the other kind to build. Competition is what produces good steamers and good service by them."

(To be Continued.)

MODERN RAILWAY BRAKES.

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The following topical question was submitted at the regular April meeting of the Technical Society of this City :

What is the Effect of Modern Brakes upon the Railway and its Supporting Structures?

The Secretary read the question, and stated that the subject had been recently brought up. It had been suggested to the Society that the powerful brakes employed in checking the velocity of a running train must have an injurious effect upon the track, particularly in curves and upon all structures that constitute the support of the railway, that is, wherever such effective devices are injudiciously applied. Considering that the greater part of the energy of a moving train, if suddenly checked, is taken up by the track, does not the modern brake become an element of danger, and, if so, to what extent ?

Are there reasons for assuming in the case of a bridge, say a draw bridge, that energy imparted to the structure continuously may ultimately lead to the destruction of it ?

Mr. von Geldern related an instance, vouched for by observations made by Mr. Hector von Bayer, a civil engineer of Washington, D. C., which might go to show that the subject was one worthy of closer inquiry.

This gentleman had occasion to examine the draw bridge over the Genessee River, at Charlotte, near Lake Ontario, and noticed that the station on the west side of the stream lay in close proximity to the bridge. Trains approaching from the east would apply their brakes while crossing the stream in order to make a halt as soon as the bridge was passed. Shortly after the completion of this structure it was noticed that it began to jam against the stone wall of the western abutment, and that it could not be turned without first chiseling off the stone facing. This operation was repeated at intervals by stone masons, whom he observed at work from time to time on the western abutment, while the corresponding gap at the eastern end was just as frequently bridged over by lengthening the rails to compensate for the cut on the opposite side.

There was every indication that the bridge traveled westward, in the direction of the moving trains. Watching a train approaching and seeing the brakes applied while crossing the bridge at a fair speed, he observed that as soon as the train felt the check the entire structure was thrown toward the western abutment until it brought up against its wall. The center or turning pier was measured subsequently, and found to have a considerable leaning to westward, to such an extent that the observer thought it necessary that this pier be replaced at an early date. The whole condition of affairs proved to him that the bridge was unsafe, and made so by an injudicious application of the air brake, continued from day to day.

"This is the only case ever brought to notice, as far as we are here aware," the Secretary stated, "and we shall aim in discussing this subject, to ascertain whether similar observations have ever been made before."

In order to begin the discussion, the following communication was read from Mr. D. E. Hughes, of Irvington, Cal.

CONCERNING THE EFFECTS OF BRAKES.

"Not being a railway engineer, hence not touched by the invitation for written replies, and not having given this important question much consideration, my only excuse for offering this, is that, whether by truth or by error, it may present a phase that abler men will discuss to our edification.

I shall try to point out the forces that a moving train imparts by means of brakes to the road-bed, but will not dwell here on the importance of not overlooking them when designing curved trestles, draw-spans, cantilevers, suspension bridges, etc., nor ask if they have *always* received the considerations that their magnitude demands.

There is no need to tell here the old story of the kinetic energy of the moving train and revolving wheels being never lost, but transformed, producing heat and other molecular disturbances, for, however interesting this may be to the physicist, it does not so much concern the engineer. Suffice it to say that living force can not be transformed without the opposition of some other force outside of the moving body. Suppose a train running on a straight, level track and gravity suspended. It will go off on a tangent. Stop the engine, and put on the brakes. Most of the kinetic energy in the revolving wheels will be transformed into heat, etc. The rest is shared with the train till all revolve slowly together, the center of gravity however pursuing a straight line with velocity unchanged. The living force in the revolving wheels has been modified by means of the static force holding the break and journal boxes. Now with the train on the track, and gravity not cut off, the tendency to slow rotation is overcome by the front end of cars and trucks pressing the track more and the rear end less than when brakes are off.

To stop the train the whole of the living force of *translation* is opposed by a horizontal force acting lengthwise in the rail. The brake is only a means for calling this into play. The heat and wearing away of brake shoes, etc., is only the result of this opposition. The help air offers in stopping a heavy train is considered too small to be regarded here. Suppose a truck jacked up and the brake on. We must apply at the circumference considerable tangential force to turn the wheels. This is just what the track does when the train is moving and the brakes are on, except that the latter is less when brakes are first applied, because the energy of rotation in the wheels helps then to keep them turning; and it is a little more later, because journal friction, under the load, is greater. It is generally the *maximum*, longitudinal, track strain that must be provided against. This occurs when brakes are applied to all the wheels at once, and just tight enough that the wheels may be on the verge of skidding. The effect of it on the supporting structure is greater when this maximum condition is quickly attained, being like the effect on a beam or pillar of applying a load suddenly, that is, it approaches twice what it is later.

The intensity of the track force, when maximum, is independent of velocity of train. Its amount equals weight of train multiplied by coefficient of *static* friction, about $\frac{1}{5}$. When, as is the case with heavier trains, the wheel load is so great that the limit of abrasion is passed and the wheels sink into the rails, the "coefficient of adhesion" must be substituted for the above. This will reach $\frac{1}{3}$, that is, a 600-ton train with any velocity may develop in the supporting structure a horizontal strain of 200 tons. If the wheels are sliding, weight must be multiplied by coefficient of *kinetic* friction, which is variable, depending on the velocity, but never greater than the above.

Although foreign to the brake question it may be noticed here that when the engine is reversed to help make the stop the forward push in the road-bed is augmented. The calculation of this additional strain involves the use of the rate of revolution of the drivers and of a very uncertain coefficient of kinetic friction. The total strain can be approximated, however, by dividing the kinetic energy of the train by the distance in which the stopping is effected; for example: suppose a 200-ton train moving 60 miles per hour, or 88 feet per second, stopped in 600 feet. $k.\ e. = \frac{w\,v^2}{2g} = \frac{200 \times 88^2}{2 \times 32.16} =$ 24,080 foot-tons, and $24{,}080 \div 600 = 40$ tons *average*. The result is much less than the *maximum*, because the conditions of highest efficiency for stopping do not obtain throughout.

Concerning the forward push in the rails:

Ordinarily it is transmitted to the ground within a distance but little, if any, greater than the length of the train. On a bridge it must be met by the stability of the piers, or else means must be provided for its transmission to the shores. On a curve, if the force is not transferred to the ground within the train length, the tendency is to straighten the track behind the train, and buckle it ahead. If the curve is on a trestle the derangement must be provided against. The intensity of the force to be met in this case may be determined thus: Let the forces imparted to the structure by the several cars, assumed equal, be represented by car lengths of track under them, then the closing side of the polygon is the resultant, that is, the chord extending from rear to front of a train represents the deranging force. If the several "bents" are able to withstand a part of the force in question then diminish the resultant accordingly. If the curve is completely covered by a train of uniform weight and brake action, there is no *radial* force except the centrifugal that would obtain at that velocity without the brakes.

At a station entered only one way there may be a creeping of the rails, for the push of stopping trains is all one way, and in the same direction is the pull at starting although less, for the car wheels are not drivers. Such creeping does not necessarily imply an *appreciable* slip. It may be the result of an oft repeated short wave of compression traveling just ahead of the braked wheel.

The increased pressure thrown on front drivers when the locomotive is stopping is of much importance. Some of it has already been accounted for. The rest, and by far the greater part, is due to the following: The force that the brake calls into play to stop the locomotive is not directed toward its center of gravity but along the rails below it. This produces a tendency to rotation much greater than the other, and, like it, is overcome by the *couple*, manifested in an increase of pressure at the front end and a diminution at the other.

As an illustration of this last point, suppose a 60-ton locomotive all on two pair of drivers, 8 feet apart, and center of gravity midway between them, and 4 feet above the track. When brakes are applied the track force may reach $60 \times 1/3 = 20$ tons. This is one component, and the equal "stream" opposing it, acting in opposite direction 4 feet above it, is the other component of the couple tending to produce rotation. Its moment is $20 \times 4 = 80$ foot tons. This is opposed by the vertical couple acting through the wheels, of which either component equals $80 \div 8 = 10$ tons, producing in front wheels a pressure of $30 + 10$, and in the other pair $30 - 10$ tons.

DISCUSSION.

MR. W. G. CURTIS.—"I agree with what Mr. Hughes has said in his paper, in the main. We have had occasion to look into the subject from time to time. The quick-action brake was introduced some four or five years ago. We have found in railway construction that when bridges and viaducts are made of ample strength to support heavy trains, that they will resist any possible effect of friction as between the rail and the wheel when the automatic brakes are applied in their full force. The automatic brake does not act with quite the suddenness of a blow; it takes three or four seconds to get the full force of the brake on trains of fifty freight cars. Under shorter trains the emergency application is made in a little shorter time. The present practice is to apply a pressure through the brake shoes against wheel treads equal to about 90 per cent. of the weight upon the braked wheels (including weight of wheels.) The recent practice is to apply brakes to all the wheels. The heavy Pullman, and other cars having twelve wheels, are provided with brakes for each wheel, introducing what is called the "triple brake."

Locomotives are commonly provided with brakes applied to driving wheels and tender wheels, but the maximum effect in braking of the driving wheels, as stated by Mr. Hughes, is caused by reversing the engine, which the engineer can do at will in emergencies. The weight resting upon the rail per wheel, for modern standard cars, being less than 10,000 pounds, the maximum coefficient of sliding friction as between the brake shoes and wheels, and the wheels and rails, may be safely assumed at 25 per cent. of the weight or pressure. This coefficient, for modern locomotive driving wheels, carrying weights of 17,000 pounds or more per wheel, may, as a maximum, be assumed at 35 per cent. of the weight resting upon the rail, or the pressure applied through the brake shoes. On this basis, the total force applied along the line of the top of the rail when the automatic brakes are on at their full pressure, can be readily estimated. For example, if a Pullman car weighs 90,000 pounds, and brake 90 per cent. of that, that would be 81,000 pounds, and a quarter of that, say 20,000 pounds, would be the force applied along the top of the rail; but just how this goes into a structure is a little complicated and difficult to ascertain.

When the brakes are applied, heat is very rapidly developed in the wheel and brake shoe, the latter very frequently becoming redhot. Of course, that energy could not be developed and make itself visible in that form unless somewhere there was resistance. That resistance is in the rail and supporting structure, no doubt, and the energy which is not converted into heat is expended in compressing the rail; the tendency of a train moving with brakes applied is to drag the rail along with it—to compress the rail in front, and extend it behind.

I have stood under bridges and observed the effect of applying brakes when the train was running 40 miles an hour, and in all investigations into this matter taken up from time to time, as new brake equipments have been made and perfected, I have been led to the conclusion that in the designing of railway bridges or viaducts, the effect of brake application under trains carried by such structures need not be considered, for the reason that the strength of the rails, guard timbers, track stringers, etc., if adequate to carry a free rolling load or trains, and providing for all requirements of safety in floor system, will always be of ample strength to resist so much of the energy stored up in moving trains, as can be applied to produce longitudinal stress along the rails through the application of the air brakes."

Q.—"On curved trestles it would have the most effect. What provision would you make to meet it?"

A.—"From what I know of the subject, there is nothing to lead me to think that any special precautions are necessary."

Q.—"On long structures is it not always the custom to slow down?"

A.—"Not invariably. I don't think there have been any railway accidents that can be traced to brake action, but so far as my reading goes the literature of this subject is rather meager."

A TOPOGRAPHICAL SURVEY OF CALIFORNIA.*

BY PROF. WILLARD D. JOHNSON, U. S. GEOLOGICAL SURVEY.

I have been invited to lay before you a recently proposed plan for a systematic topographic survey of the valley areas of California—a plan involving coöperation of the State government with the Geological Survey Bureau of the Federal Government.

I will go into the matter at present in outline only, as an announcement to the Technical Society. Before it could be said that such a proposition had been made authoritatively, it must have received generally the endorsement of engineers. To that end I have been asked to state to you the proposition.

To propose a systematic survey, is to imply that such a survey has not yet been made, and members of the Technical Society will recall the detailed leveling and transit meandering of the recent Engineers' Department, and of the State Commission on Rivers and Harbors, yet it is true that that accurate work could be regarded only as scattered contributions to a complete topographic map. California has had a succession of State surveys, each in some degree topographic in its aims, and not only have the results been admirable, but, it has seemed to me, especially as regards Mr. Hall's reports, that recognition of their scientific and practical value has been more appreciative outside the State than within it. Yet as the plans in each case were only incidentally for map work, and in no case completely carried out, the map material is of uneven value, disconnected, and not considerable in amount. Especially it has not been thoroughly coördinated by triangulation, but has in the main been hung to the distorted rectangular system of the Land Office.

It is now proposed to have made a systematic and uniform contour map survey of all the valley and foot-hill areas of the State, to be engraved in atlas sheets of a quarter degree square each, on a scale of one inch to one mile. Each of these sheets—a quadrilateral of the earth's surface, 15 minutes extent in latitude and longitude—would include an area, varying slightly with the latitude, averaging 238 square miles ; an equivalent of about six and a half townships. The paper dimensions of each sheet, with margins would be 16 inches by 20 inches. To join these quarter degree units into a single sheet, would be to give to the great central valley alone a length of 50 feet, and to the whole State (if this inch-to-a-mile work were to

*An Address presented before the Technical Society of the Pacific Coast, April 1st, 1892. Reprinted by permission.

be so far extended) a length of nearly 100 feet. It is estimated that for the valley and foot-hill areas the number of atlas sheets would be 140. This map would be designed for general purposes ; it would not be a cadastral map ; that is, it would not show private property boundaries, but it would be a topographic map, portraying the topography, or the relief of the surface, by the modern contour method, and exhibiting in addition the drainage system ; the water bodies ; the public property, or political boundaries ; the settlements ; the railways, and the public roads ; and the canals and irrigation waterways, not of individual ownership ; in short, the map would depict, on the one hand, the natural features, and, on the other hand, the public "cultural" features.

As regards the question of desirability merely, it would seem that instant assent might be had in any intelligent community. Such will nowhere, however, be the case. The need is of too general a nature, and hard to particularize. There is nearly everywhere in the United States, as yet, lack of sufficient example. We are far behind European progress in this respect. Bearing on this question of general utility, let me outline a single illustration.

In this State, agricultural development means, in an unusual degree, irrigation development, and, if the valley areas, which comprise all the habitable and agricultural lands, are to share in the relatively dense settlement of the future United States, they must be prepared for a population of millions, and a population dependent upon complex systems of irrigation. Such systems must inevitably become greatly elaborated in detail, and elaboration will, in a measure, be a matter of natural growth, not to be deliberately planned, but to be directed by circumstances. Complexity is inherent in the irrigation problem, for there are many factors, and under the best proportioned scheme, puzzling alternatives must present themselves as development approaches the extreme attainable limits of expansion ; but an unnecessary complexity, arresting development, is early introduced where there is not full information that will indicate all the factors, and that will outline the remote maximum possibilities. From such arrested development escape will mean a radical remodeling and an abandonment of much costly inadequate work. There is not lacking in California illustration of haphazard and bad beginnings in irrigation development, though there are several brilliant examples of thorough engineering work that the rest of the West is following ; work that must be vastly extended and greatly diversified. All the irrigable and otherwise cultivable areas of the State are yet at the beginnings of their settlement, and their future is to a larger degree than anywhere in the East a matter of engineering forethought and provision. To such engineering problems the controlling factors, directly, or indirectly, will be space relations, and topographic configuration.

The densely settled states of Europe have, in the last fifty years, surveyed and resurveyed their areas, until experience has elevated the standard of their maps to that outlined above; and cadastral surveys, on much larger scales even, have been extended over thousands of square miles, at a cost per acre that, in this country, would, as a rule, be prohibitive.

In the past ten years several of our Eastern states have followed this abundant European precedent. Such minutely comprehensive presentation of geographic facts is a mark of advanced civilization; it is indispensable as a general convenience in a thickly populated country; yet its highest value would come if it were to precede dense settlement, and the intricate evolution of public works. During the progress of the topographic survey of Massachusetts, a statement was made before the Boston Society of Civil Engineers, by an engineer of the Boston and Albany road, that if such maps had been obtainable at the outset of railroad building in that State, their value in the avoidance of mistakes in general location alone would have been two millions.

The valley areas of California foot up about 33,000 square miles —four times the total area of Massachusetts. The cost of their survey would possibly be $200,000.00. The time required to do the work with thoroughness might reach six years. The expense annually would not exceed $35,000.00, and finished atlas sheets would be forthcoming at the rate of twenty or more a year.

But it is proposed that the State coöperate with the U. S. Geological Survey in this work, leaving its execution to that organization, and sharing equally in its cost.

Normally the map work of the Geological Survey is not on this large scale, and of this detailed character, but is adapted both in scale and degree of topographic detail to requirements for geologic representation. Exception has been made, however, in the Eastern States above mentioned —in Massachusetts, Rhode Island, Connecticut, and New Jersey, and, I believe, also recently in Pennsylvania and Maine; but these exceptions, and the finished State maps referred to, have been made at the request, and with the aid of the States themselves, to meet at the same time both their needs and those of the general government.

The Geological Survey has been engaged for a dozen years on the unprecedented task of mapping, in contours, three million square miles. Topographic maps are a prerequisite in geologic work. In the founding of this survey the several earlier organizations for exploration and surveys were merged into the present organization, and the present system and methods of the geographic branch are a development out of this inheritance of experience and training.

The great task of mapping the United States is proceeding with steadiness and despatch, yet, measured by the total of the area to be mapped, progress appears to be gradual. Also, following the lead of systematic geological investigation, rather than any symmetrical order of expansion, map work has been spread simultaneously from many widely-separated centers, ceasing for the time being in any region upon the completion of its special study. One of these regions, considered geologically as a unit, is that of the Sierras of California. Here there is actively under way, and has been under way for several years, an elaborate and detailed geologic investigation of the gold belt, so called; and here also, begun somewhat earlier and keeping a little ahead, topographic work is in progress. Of this survey of the Sierras, sixteen sheets are now finished, uniform in general plan and paper dimensions with those above described, but on a scale approximately one inch to two miles, or exactly $\frac{1}{125000}$, including nearly 1,000 square miles each, and with contour intervals of 100 feet. This smaller scale map work presumably will continue without interruption until the gold belt, and probably also the whole of the mountainous area of the State shall have been completely mapped; and this considerable work, according to a uniform and well-coördinated plan, may be finished within the next four or five years. But the valley and low foot-hill areas, economically the more important, will be omitted; or, if surveyed at all, will be surveyed upon the smaller scale, and with the larger contour interval, adequate for geologic purposes, but quite inadequate for economic purposes.

The larger scale would be double the present scale, and experience has shown that the cost also would be double; but the map area for any given ground area, would be four times greater, and the general usefulness would have a ratio greater by many times.

To summarize the case for this State: We recognize at the first thought of comparison, that California is topographically unlike the Eastern States referred to; it has a mountainous area of Alpine massiveness and roughness, twice the size of all New England, and it has in addition a spread of agricultural lands four times the area of rock-encumbered Massachusetts, and not in scattered patches among hills, but in great valleys, one of them matchless in extent and promise. In the survey of the mountainous area the general government is at present actively engaged. The work is of the highest modern type; the scale is well adapted to the country, and no expense will attach to the State. Eventually, when Congress shall authorize publication, the atlas sheets, nearly 100 in number, may be had, presumably, at the cost of paper and printing—about five cents each. For the survey of the agricultural and habitable area, on the other hand, there is no present plan at Washington, and if there were, the resulting map, uniform with that for the mountains, would not meet the economic needs of the State, though meeting the needs of a geologic survey. It is thus seen that, unlike the Eastern States mentioned, it is not necessary to map the entire State on the inch-to-a-mile scale—that for about 125,000 square miles the smaller scale is sufficient; and that this work is now in progress and well advanced. For the more valuable one fifth remaining, however, a much more detailed map is needed. The precedents offered by the eastern seaboard states presumably might be followed here, and this more detailed map secured at half cost—the additional cost of the increased scale.

I have recently been requested by the State University to ascertain whether the geological survey would follow in California the New England precedent, if a like request and offer were to be made by this State. I am authorized by Prof. Thompson, Chief of the Western Division of Geography, to say that such a proposition would be favorably received.

ESTABLISHED PRACTICE.

Mr. W. C. Kerr in an article in the *Street Railway Journal*, on engineering *vs.* word painting, contends there is no such thing as "established practice" in constructive engineering work and argues the point in respect to steam plants, successfully perhaps, but the expression objected to, does not apply to such cases or to any case when conditions vary, but does certainly apply to a very large share of work adapted to uniform uses.

There is for example established practice in marine engineering, a field much more extensive than electric station plants. There is not only established practice but very uniform practice, even down to contour and color. Mining machinery as made on this coast is an established practice. A search through all the circulars and catalogues will disclose very uniform features in the main elements such as hoisting works, stamp batteries, amalgamating pans, shafting and even steam engines for mining purposes.

If American engine lathes are not an established practice then there can be no such thing, so are most standard machine tools, in iron and wood working.

So nearly is there fixed practice, in what may be called the implement trade, that business is done on "discounts" from uniform lists without much reference to firms or special makers.

In railway work there is certainly established practice, in many cases agreed upon in conventions, and followed with few exceptions by all the different lines. We do not mean that designs are just the same, or that all details are uniform, but the main features such as the size of axles, cranks, sometimes boilers, frames and so on.

A fair proposition is to say that for the attainment of a purpose in itself uniform, there is a near approach to uniform practice, not only in one country, but in all countries at this day. If Mr. Kerr will examine, as no doubt he has done, the designs of Corliss engines he will find from among a hundred makers a practice very nearly uniform and hence "established".

THE TECHNICAL SOCIETY.

The April Meeting of this Society was held on the first day of the month, at their rooms, 819 Market Street, the Vice-President, Mr. Luther Wagoner, presiding.

The following new members were elected :

Andrew Fraser, Mechanical Engineer.........San Francisco, Cal.
Edward C. Jones, Engineer...... ....San Francisco, Cal.
Chas. David Marx, Professor Civil Engineering of the Leland Stanford, Jr., University.
Leon H. Taylor, Civil Engineer................Long Valley, Cal.

Five new names were proposed for membership and referred to the Board of Directors.

A paper by D. E. Hughes, entitled, "The Sickle or Perfect Railway Curve," was presented, and announced by title.

A principal part of the session was occupied in discussing a topical question relating to railway brakes. This discussion, so far as conducted, will be found under another head.

The subject was opened for discussion by reading a communication from D. E. Hughes on the effect of the railway brake, and another by Alexander Watson on the methods of braking cars employed by street cable railways, wherein the author gave his opinion as to the efficiency of such brakes on the steeper grades of streets.

The discussion dealt mainly with the subject as relating to modern *railway* brakes, the object being to determine if such effective devices, applied as occasions demand, may ever become elements of danger by injuries to the track, more particularly in curves and upon bridges, in as much as the energy of the train must be taken up by the rail and the underlying structures.

Professor Willard D. Johnson, of the U. S. Geological Survey, addressed the Society, stating that a movement had been on foot to inaugurate an extensive topographical survey of the State, and that in order to carry out such useful and necessary work, it would require the aid and support of the professional engineer and the scientific societies. He explained at length the proposed method of making these surveys, the time that would be required to complete them, and the yearly appropriations necessary to cover the expenses of the topographers, who might be reasonably employed in such service for six years.

Upon motion it was ordered that the Society endorse the plan proposed by Professor Johnson, and to lend him its hearty coöperation in his endeavors to secure the approval of the authorities of the State; and that a committee of three be appointed to confer with Professor Johnson in effecting a plan of procedure.

The Chair appointed Messrs. Grunsky, Curtis and Vischer, and instructed them to call a meeting for the special purpose of agitating this question; to invite the officers of the State Mining Bureau, the professors of the Universities, the State and Federal officers interested, and the reporters of the principal newspapers, in order to create, at once, a public interest in this subject.

Notes and Comments.

Attention is called to the paper of Professor W. D. Johnson, of the U. S. Geological Survey, which appears at page 430 of this issue, and to the subject of a State topographical survey therein presented. The appointment, by the Technical Society, of Messrs. Grunsky, Curtis and Vischer as a committee to coöperate with Professor Johnson, is a judicious selection of energetic men, familiar with the subject in the abstract, as well as in relation to the value and importance of such a work in this State.

The University of California proposes to add a new college of mechanical arts, and the sum of $50,000 has been voted by the regents for that purpose. The curriculum and other particulars will appear in the next register, and it is too soon to form an opinion respecting the nature and objects of the new college. One thing, however, is apparent, that the University of California, as well as kindred institutions all over the country, are awakening to the truth of Mr. Carlyle's well-known sentence in "Hero Worship," where he says, "The true epic of our time is not arms and the man, but tools and the man—an infinitely wider kind of epic."

The River and Harbor Bill, before Congress, appropriates $1,700,000 for the improvement of Humboldt Bay, in this State, the amount to be paid out in annual installments as required. This is an important matter for Eureka and the Humboldt region, especially if that city will supplement the Government work outside, with corresponding dock improvements inside, which is the least they should do. The appropriation is liberal, and no doubt sufficient, especially as the U. S. Engineer Corps and other engineers now understand pretty well how to deal with the harbors of this Coast. Mr. von Geldern's essay, in the March number of this Journal, and yet to appear, will show this, and that for the future we may expect a tolerably successful control over such entrances as that at Humboldt Bay, which is one of the worst.

It is sometimes claimed that scientific men do not invent anything useful. We have many times pointed out the error of this, and will refer to Dr. Otto, the inventor of what may be called modern gas engines. His work covered not only the thermal problems and conditions, but also the mechanical agents of application. His engines are known all over the civilized world as the first economical and commercial success that had been attained in the art. We have, elsewhere, noticed the equipment of a mill with Otto engines of 170 horse power.

Mr. Adolph Lietz, of the Lietz Instrument Company in this City, has commenced a journey through the old world to study the progress of the art there, in optical, engineering and astronomical implements. He will visit the various observatories, and works for this manufacture, and will, no doubt, gain much information of value to his firm and business, as well as to this Coast, where there is, for the population, a wonderful amount of scientific instruments in use. This is a manufacture in which the German people have excelled, and are likely to excel in future. Their tastes, habits and methods all favor the patient and painstaking skill which must enter into precise work of the kind. Our own country is not without distinction in the same line. Alvin Clarke, of New Haven, Conn., and Mr. Brashear, of Pittsburgh, may be mentioned as foremost in certain branches of the art of scientific instrument making.

It is singular that no tin plate works have been proposed on this Coast. This port is in the direct line of trade in pig tin from Australia and the Straits. Much of it comes this way now, and the local consumption alone would occupy the resources of a large plant. Not only this, about all that has been done in producing tin has been here in California, and the product has been carried down to the Isthmus, across there, and on to New York by steamer. Fuel is dear here, and so are other expenses connected with such an industry, but the difference from the Eastern States must be more than balanced by freight charges. Ships coming out from Indian and Australian ports would be glad to bring tin at a rate much less than to New York, and the commercial conditions seem to favor rolling and tinning plates here.

The swindling recently practiced here by prominent merchant firms in evading custom's duty is one of the vilest commercial crimes that can be committed. Not only is it equivalent to stealing directly, but is an insidious and contemptible means of destroying the property and credit of many honest people who pay the dues on imported goods. There is an excuse sometimes for smuggling, in the fact that many people regard this method of raising a revenue for public purposes unjust, but so far as we have noticed every case of smuggling reported for years past has involved the faithful adherents of a tariff system of taxation, men who love their country and its laws, for the opportunities afforded to themselves for cheating their neighbors. It is exemplified in that old motto of "Our flag and an appropriation." Charles Lamb, we think it was who said that patriotism was the last refuge of a rascal, and the truth of this is not wanting in modern examples.

The Pelton Water Wheel Company, of this City, are constructing a water wheel 36 inches diameter, to operate under a head of 2,100 feet, or a pressure of more than 900 pounds per square inch. The wheel is to run at 1,150 revolutions per minute, and have a speed at its periphery of 10,805 feet per minute, which is at least one third faster than circular saws are driven. The wheel is to be placed in one of the Comstock mines, and, in addition to the depth of the mine, is to be fed from the Virginia water mains, which have a pressure of 198 pounds to begin with. The diameter of the jet will be only 0.15 inches or about $\frac{5}{32}$ inches. The wheel will be of solid steel, a tempered plate $\frac{3}{8}$ inches thick. It is a remarkable case, and will be watched with much interest, various kinds of phenomena will, no doubt, arise, and in respect to erosion of the surfaces, especially of the nozzles. This will be by far the greatest head or pressure ever applied to a water wheel.

The death of Mr. J. Van Depoele, at Lynn, last month, removes from among electrical engineers in this country one of the foremost men, a pioneer in both light and transmission development, and a man of commendable and happy character in every way. He was a native of Belgium, and only forty-six years old. His portrait indicates a strong constitution, and one cannot resist the conclusion that either himself or his physicians failed to apply in his treatment those methods that were characteristic of his profession. For a strong man at forty-six to leave his laboratory for the grave, when surrounded by all the advanced methods of care and treatment, is anomalous, to say the least. His name and also appearance, denote his Netherlandish extraction. At his birth Holland, Flanders and Belgium were practically one country. We had, just at the time of his death, received from Mr. E. H. Booth, formerly of this City, who was associated with Mr. Van Depoele, a letter in which he speaks in flattering terms of the professional skill and high qualities of his chief.

Engineer Manson, of the State Harbor Commission, will come near finishing in April the concrete forewall of the water front, from Market to Clay Street, and promises that the sand filling and interior work will be done before September of this year. The work, from the beginning has been of a very perplexing kind, because of the interfering traffic, and at first the coffer dam or caisson part also, but this goes on now as regularly and successfully as routine work of any kind. Engineer Manson is an example of endurance. Beside the public works under his charge, every detail of which passes under his inspection, he finds time to investigate problems in physical science of an abstruse character, and, at this time, is prosecuting some inquiry into the phenomena attending on the movement of the external, or undisturbed strata of the atmosphere. This matter will form the subject of a paper to be read before the Technical Society at the June meeting of this year.

In cities where water is scarce or valuable it is an exceedingly wasteful method to use it from the mains at a pressure of 40 to 60 pounds per inch as is common in all American cities. Here in San Francisco, most of all, is needed a high-pressure system, and it is strange that when there is so much hydraulic apparatus made and employed, and when every circumstance favors high pressure, no one has moved in the matter. In England a number of cities have such a system laid down and working; among them London, Liverpool, Hull and Birmingham, and in each case, so far as has appeared, there has been fair and regular profits earned, and the method has given much satisfaction. The amount of water consumed is inversely as the pressure employed. That, in the cases above named is 700 pounds to an inch against 50 pounds here, and the proportion of water consumed 1 to 14. As a matter of fact the cost of operating elevators is much reduced by the high-pressure system, also their first cost and convenience, while there are a great many other uses to which water pressure, at the present pressure, cannot be applied mechanically or profitably.

The Mechanics' Institute, of this City, is an anomaly. It is typical of our time when money getting is the aim of all ambition, and its acquirement the stamp of rank. What the accumulation of a million of dollars has to do with the ostensible purposes of a Mechanics' Institute it would be hard to explain. As an endowment, or employed as an endowment, the purpose of the fund would be more clear, but, as it is, our Mechanics' Institute enjoys the questionable distinction of having the most money of any similar organization in the country. Considered as an institution for promoting the mechanic arts, the only function of any importance is in a reference library of great value, parts of it nearly inaccessible for want of room, and an extensive file of serials open to members. The exhibition part has, for some years past, had little to do with mechanics, or industry even, if we consider the relation these latter bear to other advertised attractions that draw attendance. Conservatism is a good quality, and especially so in organizations like the Institute, but this spirit can be carried too far, and is, we think, in the present case.

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The *Locomotive Engineer*, with a candor that has always been a conspicuous feature of this journal, has set off a department devoted to the proceedings of a "liars' club," we say set off, and in that fact rests the novelty. The idea is original and good, because the general diffusion of lies throughout subject matter, the opposite and common method, is inconvenient and misleading. We once attempted to mark out this class of matter in various serials, by induction, deduction and waiting for contradictions. This was abandoned for the shorter method of scoring the true or accurate part. Without joking, one of the most serious things connected with editing a journal is to avoid the pitfalls of inaccurate and erroneous statements taken up and passed on as news or as facts, things that have no foundation whatever in truth. The "Ananias Club's" proceedings, chronicled in the above named department, is modest in comparison with what one meets with in the serious columns, especially of secular newspapers.

The following is a list of the papers to be presented at the San Francisco meeting of the American Society of Mechanical Engineers, on the 16th to 19th of this month, at the Academy of Sciences:

Economy and Efficiency of the Steam Engine.—C. H. Peabody.

The Electric Railway as Applied to Steam Roads.—P. J. Dashiell.

The Density of Water at Different Temperatures.—A. F. Nagle.

Some Tests of a Portable Boiler.—Wm. O. Webber.

Compounding Centrifugal and Load Governing by a Rotary Piston Valve.—Wm. S. Aldrich.

Notes on a Problem in Water Power.—John Richards.

An Experimental Locomotive.—W. F. M. Goss.

Utilization of the Power of Ocean Waves.—A. W. Stahl.

A Self-Lubricating Fibre Graphite for the Bearings of Machinery.—John A. Cooper.

Autographic Recording Apparatus for use in Testing Materials.—Thomas Gray.

The Measurement of Power.—Thomas Gray.

Machine Moulding.—Harris Tabor.

The Steam Distribution in a form of Single Acting Compound Engine.—F. M. Rites.

On the Elastic Curve and Treatment of Steel.—Gus. C. Henning.

A Novel Fly Wheel.—C. H. Manning.

Friction or Lost Work of Cable Railways.—W. R. Eckart.

An Experiment with Aluminum.—W. W. Christie.

Summary of Results of Principal Experimental Measurements of Performance of Refrigerating Machines.—Denton and Jacobus.

Two Cylinders *vs.* Multicylinder Engines.—Green and Rockwood.

Sir Henry Bessemer has suggested by far the best use for aluminium that has appeared, making it into small coins. By alloying it to a small extent its melting point is raised beyond cheap counterfeiting. It is non-corrosive, and has the coin requisites in full degree, and, above all, lightness of weight that would enable its selection by feel in the dark. It would be preferable to copper or nickel in every way, and there is only, at present, fluctuating or uncertain value to contend with, but this would make no difference at all to our friends who contend that such value is a legislative matter. They could easily pass a law making an aluminium coin as good as any other coin, if not better. Sir Henry is a practical man, and we commend his suggestions to the free silver men and others.

Two hundred and fifty idle iron furnaces for the present time or for the year, as may safely be estimated, is one of the results of "stimulating" industry. A more healthy plan would be to let such industries grow gradually and healthfully as the market demands the product, and this, if other prices were let alone, would be also gradual and healthful. Anything affecting prices follows like a wave all over the country, and not only affects particular commodities, iron for example, but reacts upon scores of other industries and they on iron. The country that maintains stable prices is the one that, in the end, is most prosperous. "Booms," whereby prices are raised above their normal level, are always compensated by a sinking below that level. It is true of all human interests—a law of development.

It may not be pleasing to the deep water ship builders to be told that the Lake yards have distanced them in marine engineering, and also in what we call naval architecture, but there are reasons for such an assumption, omitting always "whalebacks." The *Marine Review*, of Cleveland, Ohio, recently published a fine plate of the triple engines for the steam yacht *Comanche*, that, taken altogether, is one of the finest examples of marine engine practice that has ever been produced. There are enough parts and no more. All are accessible, symmetrical and convenient. The connections are long, every part is well braced, and no material or room is wasted. The lake practice is an example of what American builders can do when they have equal chances. The same thing would be done in foreign traffic if there were like conditions and fair competition, but when material costs twice as much as our competitors pay, and the traffic is hedged about with antiquated navigation laws, and a wall of taxes and charges, the race is one sided. Our ocean marine does not need bounties or subsidies, it only wants "letting alone," skill and enterprise will do the rest.

The tunneling, and other work, through the Cordilleras, between the Argentine Confederation and Chili, has so far progressed that passengers are sent across, as well as around, South America. The journey from Buenos Ayres to Valparaiso is made in 76 hours, and the fare is the same as by steamer through the Straits of Magellan, but the latter journey requires twelve days, or four times as long, but the train time will, in the end, be reduced to 30 hours or less, and the fare, no doubt, reduced accordingly, but will never be cheap in proportion to mileage, The railway will be expensive to maintain, as it has been to construct, and will moreover be a monopoly. In traveling from here, if there were proper connections, one might save ten days or so over going to New York by the sea route.

The recent announcement, by the Commissioners of Patents, that printed copies of patents cannot be furnished for want of room to store them is the most remarkable bulletin that has ever emanated from that Bureau, and is a disgrace to Congress and the country. If there is not room it should long ago have been provided. The Patent Office has a balance of earnings exceeding $3,000,000, and to have no room for storing copies of patents is preposterous and provoking. Printed copies are an essential feature of modern procedure, and if the Government cannot print and store patents they can contract with some firm to do so, permitting them to sell copies to persons who require them. The patent office is a national institution, but there are no "national" congressmen. They all "represent" some section, including themselves and their friends, but seldom the country at large or its interests. There is something to be said in favor of such a system and a great deal against it, especially in such matters as that of the Patent Office and other offices, because the crowding there is owing to encroaching of the Department of the Interior, which should have its own ample room elsewhere.

There appeared recently, in some place not now remembered, a jocular comment upon the educational methods of our time, saying that very soon we can expect to see graduates of Yale and Cambridge collecting fares on street cars, and performing similar work. Applied in respect to technological schools the same remark holds good, with the difference, however, that a mechanic who is a graduate of a college is apt to be a very good workman, while a Yale graduate is not at all likely to make a good street car conductor. The exclusion of foreign people, who are content to work in menial pursuits, and the education of nearly all our own people up to a point where they will not do any but intellectual work, raises a problem for the future. So far as machines take the place of hand performance, and that includes the main part of all mechanical work, no danger need be apprehended. In secular or general education the result may be different. There are many branches, such as mathematics, applied science and mechanics, that have direct application in almost any kind of practical work, but Greek, Latin and Belle Letters are not important, in well digging or fruit gathering for example.

There has been organized another trans-Atlantic line of steamers between New York, Philadelphia and Liverpool, called the Atlantic Transport Line. By organized is meant, in this case, the money has been paid in, a steamer contracted for with Harlan & Wolff, of Belfast, the builders of the White Star steamers. It is common to announce about four times a year an American line to perform some prodigious feat, but this one is evidently no myth, and will be another American line, the third one, to be operated under the British flag. One sometimes wonders what, if anything, will open the eyes of our people to the fact that we have an antiquated system of navigation laws, and are maintaining circumstances that are ridiculous in respect to foreign shipping. The Transport Line will be the fourth one owned in this country and sailed under a foreign flag, because our shipbuilders have to pay double price for material to construct ships from. Mr. Cramp, of Philadelphia, says he can build as cheaply as Harlan & Wolff under present circumstances. Why then does he not build these new ships for the Transport Line?

Admiral Seymour, of the British Navy, has been examining the Panama Canal, and gives the following description of it. It is enough to make the heart of a shareholder sink within him to read Admiral Seymour's paper:

"Lesseps declared he would make a level canal from sea to sea for twenty millions sterling; he has spent fifty millions sterling, and only one fifth of the work is done. The Commissioners calculate that it will require thirty-five millions more to make a canal with locks across the Isthmus. The work which has already been done is rapidly falling to pieces, and it is believed that there is no human probability of that canal being cut. The river Chagres rises forty feet in a single day, and the embankment, which is to keep its waters from destroying the canal, has not yet been built. It rains sometimes in Panama an inch in an hour, and the average rainfall is five times as great as that of London. Vegetation springs up so rapidly that the whole of the works will soon be buried out of sight."

Mr. John D. Schmidt, writing to the *Engineering Magazine* in reply to Mr. Wisner's criticisms of the U. S. Engineer Corps, says:

"The Army Engineers have expended a total of $200,000,000. Mr. Wisner cites failures amounting to $13,000,000, or 6½ per cent. Can civil engineers show a better record? Why, then, do the American people demand that no bridge shall be built without approval of the plans by a Board of Army Engineers? The whole world is strewn with wrecks and failures due to ill-constructed civil works. An honest comparison of the work of the Army Engineers with that of civil engineers would establish so completely the ability, success, and fidelity of the former that even Mr. Wisner would be obliged to acknowledge the force of the evidence."

The late Trans-Mississippi Congress and the Western Waterways Convention of 1891, both endorsed, in a very full manner, the conduct of this department of the Government, so it can be seen there are two sides to the discussion, and that the criticisms of the Army Corps, which have appeared in several recent articles, are no more than can be expected in any case where General Government carries on a business that competes or conflicts with private pursuits in any way. Above all, in these times of ours, is credit due the Corps for the honesty and fairness with which they disburse millions of public money.

The *Marine Review*, Cleveland, Ohio, has published a fine plate of the engines for the steam yacht *Comanche*, built at the Globe Iron Works, Cleveland, that taken altogether is perhaps the most perfectly designed set of marine triple engines that have ever been produced. The cylinders are 14″, 23″ and 36″ diameter, with 24″ stroke. The valves are of the piston type for the first two cylinders and of the double port slide kind for the low pressure cylinder; all operated by Joy gearing. The valve boxes are all covered with flat plates, producing a very symmetrical appearance on the front view. The handling levers, six in number, are all collected on one shaft, so as to have a horizontal "pull," breast high, convenient and accessible. There are no novel features anywhere, only good, clean designing throughout, and is a model that marine engineers anywhere may study with advantage and profit.

Last month there was mention made of experiments made by Professor Ewing, of Cambridge University, England, with one of Parson's steam turbines, and unless there is some mistake, which does not seem possible, it is the most remarkable circumstance in steam engineering for half a century past. The efficiency attained was equal to that of a good compound engine of the common type, while the size, adaptation, and especially first cost, are such as to command earnest attention of practical men. A good deal of allowance must be made in such cases for favorable circumstances, and well made machinery, perhaps some the other way for future improvements, but when a little rotary machine, perfectly balanced, without contact except that of cylindrical bearings of small diameter, will give out a horse power with 20 pounds of water, it is, as before said, time that mechanical engineers were looking into the matter. The tests above named were made in Newcastle in December last, and have been carefully reported by Professor Ewing.

The development of pneumatic power transmission in its present state, is enough to cause distrust of many things classed as exact knowledge. Three years ago there was hardly a scientific man anywhere who would not at once have set down the possible economy and losses due to compressed air transmission, and would have said it is wasteful and commercially impracticable for that reason. Now matters are different. More than 30,000 horse power is distributed in Paris in a profitable manner by air apparatus, and a similar plant or system is being laid down in Berlin. In Birmingham, England, a compressed air system has been at work for several years, and now a scheme on the Popp, or Paris system, is to be laid down in Chicago, an ordinance, granting this privilege, having been enacted by the City Council and signed by the Mayor. There is a similar concession here in San Francisco, for a steam, air, or other system, that has laid dormant for five or six years, the promoters not being able to induce other people to put their money in it. It is time the franchise was rescinded, and some one else given a chance to put down a plant of the kind, for air or water.

A very prominent mechanical engineer prophesied some years ago, that internal combustion engines would, in the end, drive steam engines out of use for stationary purposes. The reasons were that gas engines would prove more economical as to fuel, safer from accident, and cheaper in first cost. The power of single gas engines keeps increasing. Messrs. Schleicher & Schumm, of Philadelphia, had, some time ago, reached 100 horse power with their engines, and the makers of the same engines, the Otto type, in England, have just fitted up a flour mill with 170 horse power, developed by a twin gas engine with two cylinders, 17 inches diameter, 24-inch stroke, 156 revolutions per minute, using producer gas made from anthracite coal. The mean pressure in the cylinders was 78 pounds per inch. The gas was produced by passing high pressure steam through incandescent fuel, and, of course, required a steam boiler and its fittings for that purpose. The direct use of volatilized hydro carbons, as in the engines made here, and also by the Otto companies, should compete on the same basis, unless there are impediments to the operation of engines of large size.

An audacious inventor, or adapter, at Cleveland, Ohio, has made a railway brake by lapping a common rope several times around a drum on the axles, and then straining the slack end to cause friction. This is coming back to first principles, so to speak, and there is a large possibility of its being the best brake that has been made or invented. We brake steamboats in the same manner by turns around the bits, timber heads, or cleats. It is one of the most common and simple of all methods of creating and controlling friction, and why not apply it on street railway cars? Besides the resistance on the drum around which the rope is wound can be utilized by attaching the taut end to equalizing bars, and thus a double action be produced. There is no limit to the power in proportion to the "setting" strain; that is merely a question of the number of wraps on the drum. About twenty years ago, Mr. William Rider, of hot-air engine fame, proposed a friction clutch on this principle, made by coiling a spiral, expanding spring within a drum, and offering resistance to the "slack end." It was ingenious, but for some reason did not survive.

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The Brush Electric Company have in use, in Rochester, New York, 800 motors, ranging from one half to twenty-five horse power, and it stands without doubt the most extensively equipped city in this country in respect to electric power distribution. The falls of the Genesee River, at Rochester, give cheap power for generating current, and the large number of diversified industries carried on there has been favorable for such a system. It is estimated that 3,000 people depend upon apparatus driven by electric motors, and the use is extending rapidly, even out into the suburbs and country around.

There are reasons for believing that the rate of suburban travel can be much increased without much danger, or without any danger, if the lines are properly built, and guarded. In some recent observations at Buffalo, N. Y., authentically reported, the speed on the inner, or city end of the railways there was about ten miles an hour, or 25 per cent. more than our quickest cable service here, while outside the city the speed rose to 17 miles an hour. The limit of speed is not so much determined by danger of the trains under way, as in stopping frequently, and the wear and tear from that cause. The American people have become so accustomed to "level crossings" that accidents from high speed, or full speed trains are quite rare. For suburban lines the danger is less in proportion to the number of people exposed than for country lines, and there is no reason, in the case of electric roads, that when clear of the city they should not run at 20 miles an hour with safety.

The combination of electric lights with water jets, or illuminated fountains, has become a branch of the art electric. Mr. Sutro, of this City, has been searching over the matter, and proposes a fine display of illuminated fountains in his great bath establishment at Sutro Point. By means of colored lens, and various kinds of contrivances the effects are made beautiful, artistic, and will be a great attraction in the new baths, or amphitheatre, it may be called, now nearing completion. It is wonderful how the technical details of this work, including masonry, wood, iron and glass, have been scanned and selected by Mr. Sutro himself, and when done, if it meets his expectations, will be a satisfactory reward for his pains.

If the accounts are true of what Messrs. Siemans & Halske, the celebrated German electrical engineers, have done in electric railway building, it is quite time that some accurate knowledge of these operations were disseminated in this country. A correspondent of the *Street Railway Journal* in the March issue, says: "I found the cars at Buda Pesth being operated with one third the amount of power used by an overhead electric line of which I had some knowledge in the United States." These remarks apply to a conduit underground system, erected by Messrs. Siemans & Halske, at Buda Pesth, and are in connection with other comments of much interest. The whole civilized world is now in the race of electrical improvement, and it is not to be expected that any one country will excel in all branches of this comprehensive science. The laws and customs of the old world promote, or force, the adoption of underground or enclosed conducting lines, and it will not be strange if that system has it earliest successful development under these circumstances. It is reported that Messrs. Siemans & Halske have secured land, and are erecting in this country a large works to carry out their system of underground conduits for electrical railway lines; also, that their failure to secure at Chicago the space and opportunities to exhibit apparatus has been a cause of founding the manufacture in this country. This is by no means as well as if the system had originated here and the works founded by American capital and skill, but to assume that the country is not to have the benefit of the very best methods is not a fair or tenable assumption.

Mr. Edison is a wonderful contriver and experimental investigator, who, with the most complete resources that have ever been enjoyed by anyone, has developed more, perhaps, than any living electrician in the way of discovery. Had he been a profound mathematician and scientific man his discoveries would, no doubt, have been less, because electricity, as an element, is not one to be dealt with by analysis and comparison. It has been a difficulty to arrange formulæ and accurate statements as fast as physical phenomena have called for such treatment and classification. Mr. Edison has now set up another branch of phenomena that will call for a book or two, and some years of figuring to reduce to a system. We mean his earth transmission scheme, described in a recent patent of his. The following extract will show the nature of his latest invention:

"I have discovered that if sufficient elevation be obtained to overcome the curvature to the earth's surface, and reduce to the minimum, the earth's absorption, electric telegraphing or signalling between distant points can be carried on by induction without the use of wires connecting such distant points. By this method ships can telegraph to each other at sea, one vessel being able to communicate with another far away and out of sight. If a balloon in New York should be sent up to a great height equipped with a condenser, and held to the earth by a rope cable in which there was a strand of wire, and another similarly equipped should be sent up from London, a circuit would be formed through earth and air without the aid of wires for transmission, through which messages could be flashed at a greater speed than has ever been attained by any other system."

* * * * * * *

An exchange claims that the Mollie Gibson Mine, in Pitkin County, Colorado, is the largest paying mine in this country, next to the Calumet and Hecla copper mines on Lake Superior. For a time the Granite Mountain Mine, in Montana, exceeded the Mollie Gibson Mine, paying as much as $200,000 a month in dividends. Now, the Granite Mountain Mine is dividing $80,000 per month, and the Mollie Gibson paid $150,000 for March. The first dividend was paid in April 1891, and since then $1,350,000 has been divided among the shareholders. It is not strange under these circumstances that the search for the precious metals goes on in the Rocky Mountains, neither will it be strange if many valuable lodes are yet found in the vast field as yet partially explored.

The mining camp of Creede, in Colorado, it is said has 7,000 to 8,000 inhabitants, which for six months is rapid growth. The place is more than 9,000 feet above the sea, and 2,000 to 3,000 feet lower than the mountain tops around the camp. Town lots are selling as high as $1,500 each, and speculation is having full swing. An exchange says there are more than one hundred of the worst men in the West collected in the camp, and it is a place of every vice, and a disgrace to the country. The place is of course out of the pale of law and is so far a new district, that it cannot be determined which of three different counties should claim jurisdiction. Perhaps neither of them desire it. A report in March stated the output of ore at twenty car loads a day, that average $1,000 to the load or $20,000 a day, which may be correct or it may not. One of these new mining camps is a study, and in some respects a misfortune.

In *Cassiers' Magazine* for March, 1892, there is a brief account of how Mr. Reynolds, of the Reliance Machine Works, in Milwaukee, destroyed the old myth respecting elastic foundations for the dies of ore stamping machines. The origin of "spring timbers" for percussive machinery, came about, no doubt, in the construction of helve trip hammers, where such elasticity for the trunnions was desirable and necessary. From this it extended to the dies or anvils, and now is found in the stamp mills of California, but not in a degree to impair their efficiency to any extent. The mortars are so heavy that their inertia furnishes a nearly solid foundation for the light stamps used. Mr. Reynolds constructed a solid stamp machine with the actuating steam cylinder hammer guides and anvil all joined, and integral parts of one structure, and crushed one third more copper ore than similar machines, having the spring foundations. This was common sense, and obvious in so far as crushing friable material of any kind, but the problem was respecting the stamp or moving parts, which were supposed to be affected by the solidity of the dies, but these parts were sufficiently cushioned on the material, and this was, no doubt, the train of reasoning followed by Mr. Reynolds. The elastic theory, in respect to such structures, will bear reconsideration.

LITERATURE.

Irrigation Canals and Works.

BY P. J. FLYNN, C. E.

[Second Notice.]

Last month we gave some comments upon the general character of this important work and what it comprehends. In the present case it is proposed to confine what is said to the manner of treatment and subject matter of the first volume.

In article 7 on the Slope of Canal Banks, there is given a table of slopes in actual use that vary in a wonderful degree. Some canals in India are 1 to 1, others 1½ to 1, but two examples in California, the Turloch and Central canals, are 2 to 1, and in Colorado, two examples named are 3 to 1.

The author mentions that the wear upon banks is generally to a higher slope, the sides becoming more vertical and indicating a natural contour or angle. He says in respect to clearing or cleaning that

"It is only a waste of money to dig away the long slopes, which are soon recovered with silt, while in theory it does not afford a maximum hydraulic depth which it is the great object to attain in channels with low velocities."

In table 6, article 10, there is given a list of 54 principal irrigation canals, with the length, bottom, width, depth and discharge. Those in India dwarf the work in other countries. Ten canals there make up a length of 3,000 miles, or more than 300 each. The four longest have lengths as follows: 531, 503, 466 and 456 miles. The bottom width of eight canals given averages 152 feet, the widest being the lower Ganges — 216 feet wide on the bottom, with a depth of 8 feet. The discharge of this canal, with a slope of 1 in 10,560 is 6,500 cubic feet per second.

In this country the largest canals are the Idaho, 75 miles; the Turloch in California, 80 miles; and the High Line in Colorado, 70 miles. The largest discharge is that of the Merced in California, at 3,400 cubic feet per second. The widest canal is the "Seventy-Six" in California, 100 feet wide, and the deepest are Merced in California, and the Idaho, in Idaho, both 10 feet deep.

The maximum grade, or slope, is the Turloch, 1 in 666, and the smallest slope that of the Central District in California, with 1 in 10,000.

In article 19, on the fertilization of soil by silt, there is recounted some striking facts. In Upper Egypt, where the old basin system exists, that is, where the water is run on the land and remains until the silt settles, there is no exhaustion of the soil. Under the new system in Lower Egypt, where the water is run over the land, there is deterioration of the soil to a serious extent. In Italy people are willing to pay three times as much for water from the river Po as from the Dora Baltea, because of the silt or fertilizing quality of the former.

An Idaho farmer is quoted as saying he would rather give double price per acre for muddy than clear water. An extreme illustration of this is in contrasting lands irrigated by rain, and which require continual reinforcement by manures, with overflowed lands on which silt is deposited.

In his report on the proposed works of the Tulare (California) Irrigation District, the author argues vigorously in favor of earth dams, or embankments, somewhat unnecessarily as one would think, when it is the most common form of such works on this Coast, up to 50 feet high at least. He hints at careless construction, partly of methods and partly of intent, that usually characterizes water-retaining embankments in this country, which is true, because such work is usually done the same as grading, by contractors, who often consider that "filling in" is the "main business."

In cutting through a dam in Marin County, built ten or twelve years before, there was found imbedded in the earthwork quite a tree, transverse to the line of the dam, which had been put in, no doubt, to bind the earth together!

The amount of land that one foot per second will irrigate varies from 35 to 2,200 acres, owing to climate and crops, rice consuming most. In California the extremes are 150 and 1,500 acres, 500 being an average, San Diego giving the highest acreage, 1,500, above noted. In Colorado the amount of water required is twice as much, but this, we imagine, is because of the larger area of grass watered in that State.

The depth of water required, which is a more familiar measure to people here, the author sets down for various places ranging from one to six feet, California being estimated at 20 inches average. The statistics given are extensive and interesting, including tables for various kinds of crops, and indeed all possible facts bearing on the subject of distribution. So varied, however, are circumstances and results, that abridgment here is impossible.

Report of the Commissioner of Labor, Michigan, 1891.

We have received from the Commissioner of Labor in Michigan, Mr. Henry A. Robinson, a copy of his report for 1891, and, as in previous years, set out to cull a few items of interest from the methods and facts gathered in that very enterprising state.

The report is voluminous, embracing 475 pages, and to our astonishment is not so much a collection of statistics as it is an able treatise on State economics. One half is devoted to female labor, embracing statistics of 13,000 women workers, and is by far the most critical and complete exhibit of this subject that has appeared. It deals with wages, hours of labor, health, environment, the kind of water furnished, the social facts and conditions—down to matters of apparel. There will not be, for years to come, occasion to again investigate this subject.

In the economic section it begins with mortgages on real estate, making a clear showing by cities and counties of the mortgages on all classes of property, and then proceeds to valuation and assessments for tax purposes. It is in this section that we first gain some insight into the economic objects and studies that have engaged the attention of Commissioner Robinson, and also arrive at the conclusion that next to the legislative function itself, the Bureau of Labor is the most important institution in the State; one which furnishes the principal facts and conditions on which legislative action should be based.

In the remarks upon valuations in Detroit there is the following:

"Large areas of vacant, unimproved property held for speculation have hitherto escaped their just share of the assessment levy. Something has been done during the past five years to bring vacant lands up to an equality of assessment as compared with adjacent platted property. Under the consequent increase and pressure of taxation, many owners of large vacant out-lots have platted their property and offered it in convenient sized lots for sale. Workingmen and others have availed themselves of the offer, with the result of making a wider distribution of small real estate owners. At the other end of the scale, however, the power and ability to hold and concentrate wealth into few hands, shows no signs of diminution. 207 persons, six tenths of one per cent. of the whole number owning, own thirty two per cent. of the real estate, one family alone holding one ninetieth part of the city's land value. * * * * *

If the intention of the legislature in taxing mortgages was to reach the mortgagee and compel a distribution of the tax between him and the owner of the real estate, such intentions have been realized only to a very limited extent. The total amount of mortgages upon city property filed with the register of deeds for Wayne county, in the years 1884 to 1890 inclusive, was $23,437,778; of this amount but $2,810,000 appeared on the city tax rolls for 1890."

In some interesting tables showing the value of real estate and personal property in fifty cities, it is seen that real estate is about as three to one. In Detroit, for example, the valuation per head is $855.53. Of this, $419.51 is for land. Improvements of land, $243.67 per head, and personal property, $192.35 per head. Detroit has a population of 205,000. In Grand Rapids, population 60,782; real estate values per head is $310.18, and personal property $84.23. The proportion all the way through down to towns of 3,000 people, is about as three to one.

In a summing up of these tables there are the following notes:

"One assessed real estate acre of the city of Detroit would buy 447.6 average real estate farm acres.

The rent or profit of one Detroit real estate acre would buy the rent of 629.3 average assessed farm real estate acres.

The profit of 840,000 acres, the real estate in manufactories, absorbed all the profit of farm real estate, or a value equal to all of it, and had to go outside the State to find the balance of the profit for their real estate, which was $2,711,118 in excess of all the farmers received for their total real estate investment.

One average assessed real estate acre in the city of Detroit would buy 453 average farm acres of real estate; the rent of one average acre in the city of Detroit would buy the rent or profit of 895 real estate farm acres."

In a chapter on land values and taxation, Commissioner Robinson introduces a series of circles divided into sectors, showing graphically various proportions, such as the proportion of State and National taxes. The latter is, for Michigan, placed at $10.06 per head of population. There are twelve of these diagrams, and they form a study of much interest. The National tax, that is, taxes derived from the tariff, at $10.06 per capita, is 60 per cent. paid by the farm population, while the valuation of farm property is only 30 per cent. of the whole. Another diagram, deduced as they all are from statistics that preceded, shows that by assessing all taxes on land, the farm property would pay about one half it does under the present system.

Of the assessment of taxes in New York, there is quoted from a paper by Thos. G. Shearman, as follows:

"As might well be expected, the State Assessors, on January 21, 1874, reported 'that less than 15 per cent. of the personal property of the State, liable to taxation, finds a place on the rolls of the assessor, and that of mortgages, not over 5 per cent. of the value is assessed.' In one town, the proceeds of a single auction sale of cattle, belonging to one resident, amounted to $360,000, while the whole assessment of personal property in that town was $28,850, 'a sum very much less than that obtained for one cow.' The assessors say: 'A large percentage of the personal property assessed is found entered on the rolls to women, minor heirs, lunatics, who cannot watch with the eagle eye of business men, or to trustees or guardians.' In some towns, these classes hold more than one half of all the personal property on the assessment roll. Two widows, residing in the village of Batavia, were assessed for more personal property than all the individuals in the neighboring city of Rochester, with a population of 70,000. In one town a girl, mentioned in the assessment as a lunatic, was assessed $5,000 for personal property, which the assessor stated was the full amount of her personal estate. All over the State, 'the amount of assessments depends more on the will, craft, conscience (or want of conscience) of the party assessed, than upon the law or its enforcement.' "

California comes in for a mention in the same paper as follows:

"If the assessment returns are to be believed, in nine tenths of California there is not a pound of butter; in four fifths of the State the sheep do not produce any wool; fifty counties have quantities of bee hives, but only four have any honey; personal property is vanishing from San Francisco; loans of money are becoming unknown in the rest of the State; bonds of cities and municipalities of all kinds are not held within the State to an amount equal to one sixth of the county bonds outstanding alone; and, finally, money has been smitten by a pestilence, two thirds of all that there was before the adoption of the constitution having already taken to itself wings, and the remainder being evidently on the way. One of the great objects of the new constitution was to tax railroad, telegraph and telephone companies to the last cent of their value. The actual result has been that telegraph and telephone companies are now assessed for the cost of less than their bare poles, or about $65 per mile."

Following the section on taxation, is one on strikes, giving full particulars of all in Michigan, and a list of all the principal ones in the whole country. This, and indeed all matters of interest, are treated in notes and comments, usually wanting in such documents."

Irrigation in Colorado.

We have received from Prof. L. G. Carpenter of the State Agricultural College, Fort Collins, Col., a copy of the Third Annual Report of the College; also Bulletins Nos. 13 and 16, by Prof. Carpenter, relating to the "Measurement and Division of Water," and "The Artesian Wells of Colorado." Before speaking of subject matter we cannot forbear a remark respecting the printing of these reports. They bear an imprint of the Courier Printing Company of Fort Collins, Colorado, and would be a credit to New York or Boston, and are in severe contrast with the slipshod work too commonly done on such documents.

Noteworthy too, is the title assumed by Prof. Carpenter of "Irrigation Engineer," or Prof. of Irrigation Engineering. It is quite relevant and correct, because we may look to an early time when this branch will be set off as a special profession, and one of great extent.

The irrigation works of Colorado are immense, and have been constructed in a quiet way without the usual bluster common to enterprises where the capital has to be drawn from foreign or disinterested interests. The area accessible to ditches is estimated at 6,337 square miles, or 4,068,409 acres; the irrigated areas at 1,635,000 acres. The total length of ditches for the State is 6,316 miles, and the total cost is nearly $10,000,000.

The meteorological tables accompanying Prof. Carpenter's section of the general report are exhaustive, and as one would think final.

In the treatise on the measurement and division of water Prof. Carpenter supplies a great deal of information of value. He describes the modules for measurement employed in Italy, where the subject has been considered for centuries; and also describes methods in use in this country, giving preference to the wier, placing what is called "inch" measurement as the least exact. The subject is closed with elaborate wier tables, based on the Francis formulæ.

The essay on artesian wells confirms the common theories, and is mainly statistical, but discloses one fact, that Colorado has been enterprising enough to arrange useful surveys and data for artesian basins, a thing that long ago should have had careful attention in California. The data now in the hands of Mr. C. E. Grusky, Ross E. Browne and other engineers in this City, supplemented by a little inexpensive explanation, would be of much value if put into some tangible form for public use, as is done in the present report of Prof. Carpenter.

Kirkaldy's Catalogue.

Messrs. John Kirkaldy, limited, of West India Dock Road, London, Eng., engineers and government contractors, have sent for review an illustrated catalogue of the specialties made by the company. The work is a trade publication, and at the same time a useful treatise on a subject in which people are by no means well informed, namely: Distilling and heating water. The company make a wide range of apparatus for distilling fresh from salt water; also pumping, heating and condensing apparatus, such as is employed on shipboard, and are the inventors of that anomalous process which has received so much attention lately, the heating of feed water by means of live steam, and attaining thereby a saving of fuel.

One of the most remarkable features respecting the production of iron steamships in England, at this day, is what may be called a segregation of manufacture, or a division of the industry. This applies to the motive power as well as other things. One firm will make draught apparatus, another one auxiliary engines, a third the electrical apparatus, and a fourth steering gear.

Messrs. Kirkaldy's specialty above named includes various kinds of apparatus under a trademark name of "compactum," which term relates to the very "compact" form given to the apparatus made for distilling, heating and condensing, but the main feature of the book with which we have to deal, is the useful tables and other data respecting power and steam. The typographical execution of the work surpasses anything of the kind that has appeared.

Messrs. Kirkaldy, as before remarked, were the introducers of the system of heating feed water with live steam, a very remarkable process, inasmuch as there is no loss, but on the contrary a gain by such heating. The theory of this method is set forth in the present book. It was at first regarded as a mistake, until applied to a large number of vessels and scientifically investigated. The book is one of much value to shipbuilders and owners.

Elementary Lessons in Heat.

BY S. E. TILLMAN.

Prof. Tillman is of the faculty of the U. S. Military Academy at West Point, and prepared the present treatise as a text book for practical use there, which is equivalent to saying it is pains-taking, correct and complete. It would be a matter of amazement if we could observe and realize the agency and part of heat in all that transpires around us. All motion of whatever kind, every movement we see in nature, or over our persons, is a product of heat. It is the life-giving element in nature, so vast, so far-reaching as to elude all attempts at a mental grasp of its relations.

Its study, therefore, as far as modern science can deal with its phenomena, is attractive and useful; moreover, it explains the universality of this wonderful agent in Nature's complex economy. The present work, which, so far as practicable, deals with the subject in the abstract, has nevertheless to go on to the practical application of heat in steam engines and as an agency in storms. There are a number of treatises on heat, such as Prof. Tyndal's "Heat as a Mode of Motion," and that of Box, with others, but none readable and understandable in the same degree as the present work, which is as nearly popular as the nature of the subject permits. The present is a second edition, and a book we can thoroughly commend for any library, technical or otherwise. The subject matter is indicated by the chapter heads as follows:

"Thermometry," "Dilation of Bodies," "Calorimetry," "Production and Condensation of Vapor," "Change of State," "Hygrometry," "Conduction," "Radiation," "Thermo-Dynamics," "Terrestrial Temperatures," "Aerial Meteors," "Aqueous Meteors."

The Book is sent for review by Messrs. Osborn & Alexander of this City. Price, $1.50.

Mechanical Engineers' Pocket Book.

BY D. K. CLARKE, C. E.

This book is also sent by Messrs. Osborn & Alexander, and admits of short and easy notice.

Mr. Clarke's well-known work on "Rules, Tables and Data for Engineers," is among the most valuable and best known of modern books of reference—so well known that it is to be found in the library of nearly all constructing and civil engineers, but it has been open, as all large books are, to the objection of inconvenience in use, and embracing much matter irrelevant to any particular branch of engineering work.

In the present pocket form—3½ × 6 in., there is collected such matter as pertains to mechanical engineering, and indeed the main part of the more pretentious work above alluded to. Such subdivisions of reference matter is desirable in every way, because of portability, convenience and expense.

Of what the work contains nothing need be said. The reputation of the author, who is one of the most distinguished mechanical engineers of our day, and the resources at his command, are a sufficient warrant of "quality." The book is a fine pocket edition in leather, contains 650 pages, and is sold for $3 00.

A Manual of Mining.

BY PROF. M. C. IHLSENG C. E., E. M.

This work by Prof. Ihlseng, of the Colorado State School of Mines, and formerly of Columbia College School of Mines, New York, is the most pretentious and extensive work of its class that has appeared in this country, and is brought fully down to date in respect to new implements and processes.

The work has about it a flavor that indicates either that Prof. Ihlseng has been a good while on the western side of the continent, or else been quite busy since he came.

It is a book of more than 400 pages, well arranged, well printed and well indexed, but like all technical works on branches of great diversity is not easy reading for any one unskilled in the art to which it pertains, and even in that case will not be disposed of rapidly.

In the opening chapter on "Geognosy," written in a terse and commendable style, we find the following on prospecting:

"Good, hard, common sense, observation and pluck win, and they alone. There is no mystery about the finding of mineral. Nature is bountifully supplied with precious metals and valuable minerals, but her secrets are hid. Only the cumulative information of geological experience gives any clue as to the habitat. There is no witchery or magic charm that can hasten the knowledge of the whereabouts of an ore body or deposit.

The wizard with the hazel wand, or the spirit medium who is controlled by some disembodied Comanche chief, is an impostor. No sooner is he thus equipped than he affects a versatility and occult power that transcends combined scientific knowledge. Nevertheless, to a paltry amount of "filthy lucre" he is not averse, when he plays upon the credulity of natures which are duped to making extensive explorations upon the purported provisions. This would be ludicrous, were it not also painful, to see the number of misguided men who have squandered hopes and possessions in their search for a short cut to wealth."

Perhaps the most remarkable feature of the book, and one that will commend it to four readers out of five, is its "condensed" form, forcing a style almost epigrammatical. The subject matter, treated in what we will call the "grist-mill" compilation style, would occupy half a dozen volumes of the size and be of less value.

In chapter IV, on Drifts, Tunnels and Adits, there is some account of a curious method of driving tunnels in soft material without removing any part of it. A mass of pointed wedges, or pins, 12 inches long and 4 inches diameter, are driven in to cover the whole heading, and are progressively driven forward one at a time, the whole advancing alternately and forcing out the earth. This seems incredible for anything but loose material and where there is no great load upon the top. This chapter is one of the most interesting in the book.

The author illustrates one of Knight's direct-acting hydraulic pumping engines, and remarks that such engines on the Comstock mines cause difficulty, because of their valve gearing and dealing with an inelastic fluid. Here we must find some fault, because the author evidently did not understand the Knight pumping engine, or else would have excepted it, because in these machines there is no shock, and its avoidance is a characteristic feature of immense importance. No one, so far as we know, had, previous to Mr. Knight's inventions, avoided water shock in these engines, and that he has done so is undeniable. We have stood alongside of one working against a head of 400 feet, and without watching the reciprocating parts could scarcely detect the reversing of the mechanism. There are we believe none of Knight's engines on the Comstock mines.

The tenth and last chapter of the work, on the examination of mines, is perhaps the most valuable one of all, or at least is of most practical value to those most likely to need and use a manual of the kind. The suggestions contained indicate more than any other portion of the book the consummate knowledge of the author respecting the subject treated.

It is published by Messrs. John Wiley & Sons, New York, and sold in San Francisco by Messrs. Osborn & Alexander; price $4.00.

The Californian Magazine—April, 1892.

Now in its fifth number, those without prejudice in California will be glad to concede the excellence of this publication, and be proud that in this not fertile field, can be made up of original matter, a magazine comparing with any of its class.

We are happy to point out that the editor compels a clear English idiom, free from those modern innovations of speech not quite strong enough to be called "slang," but repulsive enough to a reader educated in correct use of our language. This is a considerable claim, and one that in the end will have much to do with the success of the magazine.

It is also worthy of note that there is a tendency to "industrial" literature, and properly too. On this Coast at least, we are a business, money-grubbing people, that want our literature seasoned with the useful circumstances of life. We have not reached those transcendent ideas that in another half, or whole century, may find place in our tastes and capacities.

We make the remark without disparagement, on the contrary in a belief, that more and more will literature become blended with common material interests, as well as ideal aspirations.

The ponderous sentences of Dr. Johnson, as well as the perorations of Pitt, Burke, Fox or Webster, would be laughed at in this day when people no longer act by impulse. What we want is facts in good, plain, grammatical English. This is the scheme of the *Californian*, respecting which we have only room to say that each and every article in the present issue is commendable, and in many cases exceptionally so.

We once made the mistake, when abroad, of attempting to describe California redwood; sent for some and were laughed at. It was a cross between Pennsylvania hickory and Honduras banyan. Mr. George D. Gray has helped us out, but too late. He says in the present *Californian* that redwood has,

"Like its native State, as many true and opposite descriptions and qualities can be given of the tree and wood as of our climate and the topography of the country. The butt will sink like a stone, while a log cut from the top of the tree will float like a cork. Other lumber will shrink in width—when dried in the open air, the shrinkage of redwood is very small. Lumber from this tree placed in the ground will last for years, while the lower or butt logs are considered the most durable. This quality of durability is admirably illustrated by the accompanying cut, which is taken from the photograph of a stump of a tree ten feet in diameter, whose roots have overgrown a log four feet in diameter. The material of the latter is as sound as the day some catastrophe laid it low. From some trees you can split out a board an inch thick, twelve inches wide and sixteen feet long, while in others it is so curved and mixed that it is almost impossible to split a log, or, if you succeed, the piece is so crooked that you must "tie it up to prevent its crawling away." Some is soft and admirably adapted for turning and carving, while that from other sections is hard, and for lasting qualities in the ground is unequaled by any other wood. Some lumber that is very heavy when cut will lose two thirds of its weight in drying, while other trees will scarcely change in weight, if kept for years. Other woods, once dried, will swell when exposed to damp weather, while redwood, once seasoned, is not affected, even though soaked in water. You can obtain samples of redwood of so light a shade as to remind you of Spanish cedar, or so dark as to resemble black walnut. You can have it with grain so straight that you think the lines in it must have been ruled by hand, or, if it suits your fancy better, you may select a piece which vies with French walnut, mahogany or rosewood in the beauties of its curves and varieties of its figures. All other varieties of the cedar family, when once cut down, are destroyed, while the redwood stump will throw out a hundred green shoots and cover itself all over with verdure and beauty."

We cannot refrain from mention of the article by Mr. Moorehead on the "Ancient Mound Builders of this Country." That alone is worth the price of a volume, and a fitting contribution on a subject that has been shamefully neglected in the past.

North American Review—April, 1892.

In this number Cardinal Gibbons furnishes the leading article, a panegyric on patriotism and its corollary—war. Without wanting to treat in a frivolous manner the writings of a serious and able man, we must say that Judge Halliburton's definition of patriotism is susceptible of more logical treatment and more in accord with facts, namely, that patriotism is usually a cloak for rascality.

The Cardinal refers to the defense of the Pass of Thermopylæ by the Spartans, and ascribes to patriotism this wonderful feat of bravery. But viewed in the cold logic of facts, it was not the Spartans so much as the Persians they contended with, that were moved by what is commonly called "patriotism," that is, a desire to crush other people. The Spartans were fighting for their lives and country. The Persians for "patriotism," according to the common standard, and so far as we can see, Cardinal Gibbons' standard. The article winds up with an eloquent plea against purchased votes, and the political corruption of our times, but is oblivious to the fact that all those who at at this day oppose such corruption are apt to be called unpatriotic.

The true patriot reveres his country and flag for its honesty, its power as a civilizing and intellectual factor in the world's progress; the false patriot for its physical power to crush other people by force of arms. One is human, the other animal patriotism.

It would be more pleasing to see a cardinal of the church rise to that position which recognizes the brotherhood of humanity, and of nations, and did not find its highest development in war and "jingoism." This latter kind of patriotism now costs about one fourth of all human effort in so far as labor and earnings, and is responsible more than anything else for the demoralization of nations and their institutions.

Mr. Hilary A. Herbert, Chairman of the Committee on Naval Affairs in the present Congress, writes of "Reciprocity and the Farmer," and contends just as we have done in this Journal, that the duties remitted under the Hawaiian treaty were paid into the pockets of Mr. Claus Spreckels and a few others engaged in the sugar trade there. It requires no great wisdom to see that reciprocity with any country, or in other words, free trading with special countries, benefits only those who are directly engaged in that trade. The following paragraph from Mr. Herbert's paper will answer for a problem in figures:

"It will be seen that we have not taken the trouble to ascertain the relatively pitiful sum of duties released to our people by the Hawaiians. We simply put against our actual losses, in release of duties, the full values of all our exports. Balancing the account for thirteen years, and counting in those exports that would have gone to the islands without any treaty, as well as those that went because of it, the sum total of all our exports for this period is $35,870,801. Deducting this sum from the $43,898,978 of duties released, we have $8,028,177, which we could have realized as clear profit by purchasing and destroying all our merchandise exported to the Hawaiian Islands during the period in question."

The article on "Money and Usury" by Mr. Henry Clews winds up with an exposure of the absurdity of usury laws. Adam Smith, 110 years ago, showed in the plainest manner how usury laws operated against the very people that such laws are intended to protect. The same thing has been explained scores of times, and the practical working of such laws show this result. Yet most of our States have laws to regulate interest on money when loaned by contract. This State has happily escaped such an absurdity. Mr. Clews says;

"That bodies of men chosen by their communities at home should hold sessions professedly in the interests of the people, and enact usury statutes, would be a remarkable phenomenon did we not know that nothing is remarkable in the annals of lawmaking, and that collective folly is as natural to legislative assemblies as to breathe or walk about."

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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ELECTRICITY AS APPLIED TO MINING OPERATIONS.

BY E. H. BOOTH, BOSTON, MASS.

The benefits to be derived from the introduction of electricity in mining operations are of such far-reaching importance that a careful consideration and study of the subject becomes the duty of those interested or engaged in this great industry. The results already attained may be taken as a practical indication of the wonderful possibilities that attend the use of this unequalled source of energy. There are so many risks attending the development and operation of a mine, both from natural obstacles and those inherent in the business, that anything tending to reduce or minimize these chances becomes at once a powerful factor in the exploitation of mineral districts.

Among the most important and successful applications of electricity to mining uses is that of long-distance transmission of power. To obtain the power necessary for their operations is and has been frequently the most important problem that presents itself to mining men. Sometimes fuel is too scarce, or the expense attending transportation is too great to warrant the use of steam, while the rugged nature of the country and the distance may render impracticable the utilization of water powers by the usual methods. In such cases the use of electricity may prove to be the means of making producing properties of mines that otherwise would have to be abandoned. By its use it is possible to establish a central power station at a point many miles distant from the mine and mill. In case water power is used for generating electricity, we would establish the power station at the point to which the water could most conveniently and economically be brought. In case steam is used, the most important consideration would be that of cheap fuel, and the power station would be established accordingly.

The wires transmitting the power from the generators are led to the mine, or to several mines, delivering to each the amount of power required for its mill and mining operations; and as a high efficiency for long distance electric transmission can now be obtained, the great economy of this system at once becomes apparent.

The continually increasing loss in transmission, as the distance from the source of power becomes greater, makes the use of the hydraulic, pneumatic, steam or wire rope systems very wasteful, even for comparatively short distances, and the limit of their practicability is soon reached. While the same difficulties are presented when electricity is employed, they appear in a far smaller degree, and at the present time the long-distance transmission of power by electricity is a commercial success, and the nature of the country can present no obstacles that cannot be overcome.

The advantages offered by the use of electricity are of equal importance in surface and mining work. All operations then become a part of one complete system. The same wires which on the surface supply energy for operating the mill, lighting, hoisting, haulage, etc., when led underground operate pumps, winze hoists, ventilators, drills and locomotives, and may be used for lighting as required.

The introduction of electricity in these operations secures greater mobility of power, since it can be economically divided into smaller units.

It is only intended in this article to mention the different systems of long-distance electric power transmission, calling attention to the leading characteristics of the motors operated on these systems with reference to their adaptability for mining uses.

For any fixed loss in the transmission of power between the generator and the motor, the weight of the copper in the line may be decreased as the voltage or potential is increased. As the condition of minimum cost of installation exists when the cost of power lost in transmission is equal to the interest on the cost of the line, of which copper is the largest item, it becomes essential, when the distance is great, to employ high pressure currents or potentials. Up to this time the direct current has been almost exclusively used for the transmission of power. In electric railways the direct current is entirely used, as well as in many other power installations of importance. It is, however, a matter of difficulty to make commutators for potentials of over two thousand volts for direct current generators on account of the great number of segments required and the difficulty of their proper insulation. While this voltage will be sufficient and economical, both as regards cost of installation and operation in many cases, conditions will also be met with requiring much higher voltages, which are at present commercially practicable only through the use of alternating currents.

As in most mining work, potentials of from 220 to 500 volts are employed on account of safety and convenience, it becomes necessary in long distances to transform the high potential of the generator to the lower voltages before reaching the motors operating the machines, and this, in the case of direct currents, must be done by means of motor-generator transformers. In transformers of this class, this change of potential is accomplished by having two armature windings on the same shaft revolving within a common field, one acting as a motor and receiving the current at a high potential from the generating station at a distance; the other, acting as a generator wound for a low potential, supplies the necessary power to the motors for work at the point of operation.

The great advantage accruing from the use of the direct current for mining work is the ability possessed by motors, using this current, of exerting, for short periods, an amount of power much in excess of their ordinary rated capacity without damage to themselves when called upon to do so. This feature of direct current motors is of great value when applied to locomotives, hoists, pumps, etc., subject to varying loads, and is met with to an equal extent in motors operated by any of the alternating current systems.

The ordinary, single-phase, alternating current generators, and motors, however, can be made for developing and utilizing much higher potentials than direct current machines on account of their greater simplicity of construction, no commutators being required, the current being taken from collector rings. This is the great advantage obtained from the use of the alternating current in power transmission, as the high voltage at which it may be employed greatly reduces the weight and consequently the cost of copper in the line, a most important consideration in long distances.

Alternating currents can also be transformed from high to low potentials, or *vice versa*, by simple transformers having no moving parts, such as are required with direct current transformers. This allows the use of generators of comparatively low potential, from which the current is transformed to a high potential for transmission, and then again to a low potential for distribution. These advantages, however, are in a large measure offset by the fact that alternating motors cannot be made to start themselves and show good results, as in the case of direct current motors, and to be efficient must run in step, or synchronism with the generators supplying them with current. Neither can they be overloaded to meet extra demands for short periods, as is the case with direct current motors, which is a serious disadvantage for mining work.

The multiphase alternating current combines all the advantages of transformation and transmission of the single-phase current mentioned above. In addition to this, however, multiphase motors are self starting, and can, to a limited extent, be overloaded to meet unusual demands upon them, but not to the same degree as direct current motors.

In order, therefore, to obtain the full benefit of the variable working capacity of direct-current motors, and the advantages in the transmission of power attending the use of alternating currents of high potentials, motor-generator transformers may be employed as described above. By their use an alternating current of high potential for transmission can be reduced at the mine or mill to a direct current of low potential for distribution to the motors. Each system has its uses, which depend upon local conditions and mine requirements, and these must be carefully considered before deciding upon the system of electric transmission best suited to the work to be accomplished.

The great economy of the electric motor in the use of power is almost perfect automatic regulation of speed under wide variations of load. Its compactness, simplicity of operation and safety, all go to render it an ideal machine for the operation of reduction works.

The practicability of using the electric motor in small units for the operation of individual machines, or for portions of the work, instead of having all the power transmitted from one point in the mill by means of heavy shafting, pulleys, belts, etc., effects not only a large saving of power, but adds very greatly to the convenience and economy of operation. For example, in a stamp-pan mill, the rock breaker, which from its situation near the top of the mill, always requires long belts, shafts, etc., for the conveyance of power, can be driven by a small electric motor, belted directly to it and requiring only two small wires for delivering the energy that operates it. A further advantage will be found in the fact that as a rock breaker is in use but a small part of the time, the motor operating it can be started and stopped by simply turning a switch, obviating the use of fast and loose, or friction pulleys, which are always a cause of trouble.

The batteries can be arranged to be driven in groups of ten stamps or more, each stamp battery being provided with its motor, belted directly to the cam-shaft pulley. The heavy battery line shaft with expensive friction pulleys is thus no longer required. The motors operating the batteries require practically no effort to start and stop, and are convenient to the battery man, while friction pulleys are always difficult to operate, often stick at a critical moment, and as they run loose on the shaft, when not engaged, they require constant oiling, and in time, repairs. The motor stops with the battery, and all further wear and attention is avoided.

The expensive belt alley, usually located between the pan and battery line shafts, is also saved. The pan line shaft can be driven by a motor belted directly to it, and, if desired, can be divided into two or more sections, in groups of four pans and two settlers, with a motor for each. This division of the pan line shaft into sections, in large mills, greatly reduces its weight and cost. A separate motor is also employed to drive the clean-up pan, quicksilver elevator and blower for the melting furnace, independently of the rest of the mill. The advantage of having electric lights accompanies the use of motors, thus securing superior lighting and reducing the danger of fire. The division of the power into smaller units renders it more flexible and reliable, and enables the mill to be operated at half its capacity, or less, while running only the machinery actually required, without materially affecting the cost of milling per ton.

The advantages offered by electric haulage for mine work hardly need be more than mentioned. It is particularly well adapted for low entries, and where necessary the locomotive can be made to have little or no overhang beyond the rails. These important requirements cannot be met to an equal extent with steam or compressed air machines. The smoke and heat consequent upon the operation of steam locomotives for underground work are, in most cases sufficient to prevent their use. The compressed air locomotive, with its immense air tank occupying so much space in a tunnel, is at best a cumbersome machine, limited in its operation by the amount of air its receiving tank will hold, and is exceedingly wasteful of power.

Compared with these, the electric motor is compact, simple in its operation, so that skilled engineers are not needed, requires practically no outlay for repairs, is always ready for immediate use, and does far more work for the same expenditure of power. It is also part of a complete system, in which one central generating station supplies power in the form of electricity for all mining work. The same wires which supply current for the locomotive may be utilized to furnish power for pumping, hoisting, drilling, ventilating, etc. The necessity for a separate and expensive plant for each of these uses is removed by combination of all in one.

The direct-current electric motor is peculiarly well adapted for hoisting work. With steam hoists, in order to avoid the frequent occurrence of having an engine on a dead center when ready to start, two engines on a common crank shaft, with cranks at right angles, are usually employed. Even with two engines the maximum starting effort that can be relied upon at any time is represented by the power of but one engine, as the other may be "on the center." An electric motor has no centers, it is always ready to start to the best advantage. At the moment of starting, when the greatest effort is needed, a heavy current far beyond its rated capacity may be turned into the armature of the motor for a few moments until the load is started, when the amount or current for which the motor is intended will suffice to raise the load. In other words, a much better torque, or starting effect, is possible with a single electric motor than with a double engine hoist of the same rated horse power.

When it is a part of a general electric system in a mine, the location of the hoist with relation to the central power station is of small moment, as nothing but wires are required for the transmission of the power. In underground work electricity makes the use of a winze hoist possible in places to which a steam or air pipe could not be well led. In addition to this the hot steam pipes and hoist station in the mine are done away with, and much greater economy in the expenditure of power secured.

Electric pumps are particularly adapted for use in station work in running shafts. The wires conveying the electric energy to the motors driving the pumps are thoroughly insulated, and enclosed in an iron pipe for protection against injury. This small pipe, with the discharge pipe, are the only connections in the shaft necessary for the operation of the pumps. An electric generator, on the surface, driven by a water wheel or a steam engine, as may be required, supplies the electric current for operating the pumps. This makes a very simple and economical arrangement, both as regards installation and operation, when compared with either the steam or Cornish systems. It is, of course, possible to operate a Cornish pumping plant by means of electric motors when desired. By the use of two motors in such a case, with a pinion on the armature shafts directly engaging the main pump gear, we get the benefit of series, multiple connections, and are enabled in this way to make a reduction of one half in the speed of the motors when desired, while still obtaining the highest efficiency.

The large and massive fly wheels always required in Cornish pumping plants, operated by steam or water power, are not necessary when electric motors are used, owing to the size and weight of the armatures together with the comparatively high speed at which they run.

The problem of pumping water against high heads, without the use of pumping stations in the shaft, has also been greatly simplified by the use of electricity, and rendered very economical both as regards first cost and operation. Many advantages attend the use of the electric percussion drill in mining work, among which may be mentioned the flexibility and economy of this system.

Mines, however, already equipped with air drills and desiring a complete electric installation are, by the use of the electric air compressor, enabled to still continue their use without sacrificing any of the advantages accruing from the use of electric power in mining work. The compressor is an exceedingly compact machine, designed to be placed in a mine tunnel within three hundred feet, or less, of where drills may be operating, so they may obtain the benefit of the heat of compression. An increased efficiency of from 25 to 35 per cent. may thus be secured over what is now obtained in compressing on the surface and leading the cold air through long pipe lines to the drills.

As the heading advances, the compressor is moved forward ; this change in position will, under ordinary circumstances, be necessary only about once a month. New connections are very quickly and easily made, wires only being required for conveying the power to compressor, and wire-wound hose for connecting a receiver, which forms the base of the compressor.

The operation and speed of the compressor is automatically regulated by means of a switch to the requirements of the drills it supplies, and beyond occasional oiling requires no attention.

Having thus briefly stated some of the advantages offered by the use of electricity in mining operations, attention is called to the fact that there is nothing now being done in mining work without the use of electricity which cannot be better and more economically done with it; while the advantages of transmission and subdivision of power that are realized by its use are a sufficient guarantee for its wide adoption in mining operations in the near future.

NOTES ON A PROBLEM IN WATER POWER.*

BY JOHN RICHARDS, SAN FRANCISCO, CAL.

The present paper is to be a non-scientific one, and in other respects is not to be classified among the contributions such as are commonly presented before this Society. Neither are its objects the same. The purpose is to present some thoughts upon a very important subject, with a view to calling out further and more able discussion. There being nothing exact or determinate to deal with, there will be neither figures nor quantities included, so that no severe mental strain need be apprehended in following the remarks.

The subject is, water motors, or, as we commonly say, water wheels, for utilizing the action of gravity of water, and an inquiry into the probable conditions, inferences, or deductions which have led up to and established modern practice as it now exists in this country.

Water wheels, as we have to deal with them, may be classed as gravity wheels, including, (1) overshot breast wheels, and perhaps the Poncelet type; (2) pressure wheels, including what we call enclosed turbines and reaction wheels; (3) impulse wheels, driven by spouting water.

The classification thus assumed is, for short: gravity, pressure, and impulse wheels. These may be said to cover the various types in common use.

In modern practice the class called pressure turbine wheels constitute perhaps four fifths of the whole. These can be divided into three general types, namely: The Fourneyron, or outward radial discharge; the Jonval, or downward discharge parallel to the axis of rotation; and the American or inward flow wheels. These have come into general use all over the world, and have a literature of

* Presented at the San Francisco meeting, May, 1892, of the American Society of Mechanical Engineers.

surprising completeness. They are by common consent regarded as the most efficient, and indeed, until recently, have been the only wheels which were considered in connection with an efficiency beyond 60 per cent.

The question to be presented and the main point in this communication is, what has produced this particular form of evolution in water-wheel practice, and why has pressure instead of impulse been the principle, or mode of operation followed in all countries?

Before attempting any answer to this inquiry, it will be well to further examine or explain, in as simple a manner as possible, the nature of the class called turbine wheels.

A column of water resting upon the vanes of a turbine wheel, which are free on their reverse side, and meet no resistance there, represents complete efficiency less machine friction; and the science of turbines, to so call it, is directed to removing the impeding water and its resistance on the reverse side of the vanes, that is, on the discharge side, after the function of pressure has ceased or has been utilized. It is common to divide the effect of the water, or its functions, in this class of wheels, into gravity, impulse and reaction, but there is no need of such assumption or introducing the complex nature of these forces thus combined, because the whole is explainable as simple pressure, and all observed phenomena point to this as the "mode of action" in pressure turbines.

I am in this assumption, no doubt, transgressing upon what are called established data, but the issue is not important to the present subject, and it will be sufficient to call the active force one of pressure alone, and the resistance or loss, a result of the imperfect riddance of the water on the reverse or discharge side of the vanes, after it has performed its work by pressure, impulse, or otherwise.

Following this method of operating to its constructive features, it involves closed vessels, or conduits, not only to the water wheels, as in other cases, but around them. The wheels must be enveloped in the fluid that drives them, and contained in cases strong enough to sustain not only the static head, but also the effect of water concussion, and in most cases afford support for the wheels themselves and their shafts.

The bearings of the wheels have to sustain the weight of the running parts, also in many cases, a pressure of the head equal to area of the issues multiplied into the head. The wheels are submerged, placed at the bottom of the head or near it, inaccessible to observation, and also for repairs, calling for unusual and expensive provision in the way of bearings and other constructive features, including extra strength of all parts. The hydrodynamic conditions both of entrance and discharge, call for complicated forms that cannot with safety be built up, and pressure turbine wheels in this way become large and expensive castings, the value of which depends upon the integrity of every part. If a vane be broken or imperfect, the whole wheel is lost. The diameter being limited because of first cost, a limit of rotative speed is reached at a head of fifty feet or so, and even at that head the bearings have to run under undesirable conditions; in other words, this type of wheels does not permit control of rotative speed, that being limited by both first cost and operating conditions.

Turning now to the other type of wheels, but little known in this country, except on the Pacific Coast, the impulse class, and assuming that the force of spouting water is equal to its gravity less an inconsiderable friction in orifices, the question arises, why has not the evolution of water wheels followed on this line instead of pressure for all except low heads?

This is a very important question, one that may well engage the attention of this Society, and one that calls for explanation such as will be by no means easy or apparent. It is true that with that class of impulse wheels called "undershot," and some other cruder forms operating by the impulse of spouting water, the efficiency attained has been so low as to lead to the conclusion that the losses were inherent in the method or mode of operation, and this opinion has, it seems, become general without anyone very closely inquiring into the matter.

That the efficiency of tangential wheels driven by impulse is as high as can be attained by pressure turbines, has been proved by numerous experiments here, also by some recent experiments at Holyoke, Mass., and is beyond controversy. It has long been settled on this Coast, and as a problem no longer exists. No one here would expect under a head of fifty feet or more to attain with any known type of pressure water wheels a higher efficiency than is given out by tangential impulse wheels; but this state of opinion and practice is confined to narrow limits now, and is the more to be wondered at when we consider the rapidity and completeness of investigation in other branches of dynamic engineering at the present day, especially when the economic and constructive conditions in favor of the impulse type of water wheels, are taken into account. These we will now consider in a brief way.

There is a wide difference between a water wheel driven by impulse and one operating on the pressure system. The first cost of the former, for a given power, is one half as much, and its maintenance is still less, in proportion.

Figuratively speaking, when a wheel is changed from the pressure to the impulse system, it is taken out of its case, mounted in the open air, in plain sight. All the various inlet fittings are dispensed with and are replaced by a plain nozzle and stop valve. Its diameter is made to produce the required rotative speed, whatever that may be. The shaft and its bearings are divested of all strains except those of gravity and the stress of propulsion when the water is applied at one side only. Most important of all there are no running metallic joints to maintain against the escape of water, no friction and no leaks; there are, indeed, no running joints or bearings whatever, except the journals of the wheel shaft.

The effect of grit and sand is eliminated, both as to vanes and bearings, and there are no working conditions that involve risk or call for skill. If a vane is broken, another one is applied in a few minutes' time. If a large or small wheel is wanted, the change is inexpensive and does not disturb the foundations or connections.

Capacity is at complete control; the wheels can be of 10, 100, or 1000 horse power, without involving expensive special patterns. The speed of rotation is not confined to commercial dimensions because of patterns or other causes. It is merely a matter of choice with the purchaser or maker.

Now granting the efficiency of impulse wheels, which, as before remarked, can hardly be called in question for all heads exceeding 50 or even 30 feet, and conceding the constructive and operating advantages just pointed out, the question at first named arises, why has the evolution of water wheels during fifty years past been confined to the pressure class? Also, why has it been proposed at Niagara Falls to employ pressure turbine wheels under a head of 100 feet or more, when the conditions point to the better adaptation of open, or impulse wheels?

It is not necessary in such an inquiry to discuss the problem of horizontal and vertical axis, or other local conditions, in the case of the Niagara plant, or in any other, further than to say that the pressure class of wheels offer no advantages not balanced by equal or greater disadvantages, as will no doubt appear if there should be discussion of this subject before the Society.

Besides the object of this communication first named, there is the further one of calling the attention of the members present to the impulse or open water wheels so extensively employed on this Coast, and to suggest that, if possible, they manage to see such wheels in operation under various heads, especially under high heads. In observing a machine of any kind in motion, there are impressions gained which cannot be conveyed by description, but I warn every one against inference from this remark that the tangential water motor wheels on this Coast are not scientifically understood and treated. The problems involved may not be so many or so intricate as in the case of pressure turbine wheels, and this is fortunate, because the literature of the latter is one of much complexity to any but skilled mathematicians, and for that reason has not been of so much use as it ought to have been.

In this country, and it is a most commendable thing to mention, the pressure turbine by an inward flow, or an inward draught, has been greatly simplified in construction, cheapened in first cost, and at the same time better adapted to impure water, without losing anything in efficiency. I believe the inward flow turbines made by the Risdon Company at Mount Holly, New Jersey, have in public tests on more than one occasion shown an efficiency as high, or even higher, than the more finely fitted Fourneyron and Jonval types.

The record of American engineers in this branch is one of which they may well be proud; and now that impulse wheels of the Girard type have made much progress abroad, and have here in California been modified much as the Fourneyron and Jonval wheels have been in the Eastern states, it is quite time more attention was bestowed upon the subject in other parts of the country. Analogy in the two cases is marked. By an inward flow, American makers reduced the running parts, or the wheel proper, of pressure turbines to a small diameter, increasing its speed accordingly. This lessened the weight and cost of the wheels in the proportion of their diameters, and at the same time dispensed with the accurate fitting involved in the outward and downward flow turbines; and this, as before said, has been done without sacrificing efficiency.

The tangential type of open wheels has been similarly dealt with here in California. The running-water joints have been wholly dispensed with. The construction has been cheapened one half. The round jet has been applied in the most simple manner, with an increased dynamic effect, and the efficiency attained is believed to be more than is reached by the finest examples of Girard wheels in Europe.

Conceding these statements and facts brings us back again to the query forming the subject of this communication, namely: Why has the evolution of water wheels followed on the line of *pressure* instead of *impulse?*

A SELF-LUBRICATING FIBRE-GRAPHITE FOR BEARINGS OF MACHINERY.*

JOHN H. COOPER, PHILADELPHIA, PA.

This material is the invention of Mr. P. H. Holmes, of Gardiner, Maine.

The inventor's object is to furnish bearings for machinery upon which shafts will run without oil, or any added lubricant. Also to reduce friction and to render it more uniform, and thus, by dispensing with applied lubricants, avoid the cost, and all the inconveniences and dangers incident to their use.

This material has been made by the inventor, and applied during the last three years to machines in his own works and such as offered near by, adapting it in some cases to much worn, grooved, and damaged shaft journals. In all these places it has fulfilled the usual requirements of journal bearings, and has performed satisfactorily even where well-known and amply oiled antifriction metals had been fairly tried without success.

Many forms of bearings be may made of this material, and since they possess within themselves the means of self-lubrication, the usual receptacles, channel ways and appliances for oil, and the distribution and delivery of the same to the bearings, are rendered wholly unnecessary.

Experience thus far with this material has proven it uninjured by prolonged contact with water, oils, acids, alkalies, and to the ordinary higher temperatures; nor is it subject to change of dimensions by variations of temperature, as are the metals; so the finished articles retaining the mould sizes with unusual precision, can be used in machines with least tool fitting and finish.

* Presented at the San Francisco meeting, May, 1892, of the American Society of Mechanical Engineers.

Revolving shafts, together with such parts of machines as have contact and motion, when properly fitted with these bearings may be run continuously without any more attention than is given to well-secured pulleys, or to the shafting itself.

This bearing material is composed of selected, lubricative, natural graphite, which has been finely divided and freed from all foreign and gritty matter, to which is added wood fibre or other growth mixed with water in various proportions, according to the purpose to be served, and then solidified by pressure in specially prepared moulds; after removal from which the bearings are thoroughly dried, then saturated with a drying oil, and finally subjected to a current of hot, dry air for the purpose of oxidizing the oil and hardening the mass. When finished they may be "machined" to size, or shape, with the same facility and means employed for metals.

There can be no question about the wisdom of employing any graphite so prepared, because this process retains the whole of the graphite proper and separates from it such substances as cause friction and abrasion. In the employment of materials, which vary in quality and where different purposes are to be served, it is perfectly consistent that the proportions of such materials should vary in quantity in the several mixtures, nor can there be any serious objection to this in these cases on the score of economy, since all the components are of comparatively low cost and are readily obtained in open market.

In the preparation of these materials for pressing in the moulds no special devices presenting difficulties of invention or manufacture are required, but simply the mixing thoroughly together in water of a fibrous pulp with a fine powder, and of transferring the mixture to the moulds by hand instruments or by common pumps.

The moulds themselves, may be said in a general way, to be of such construction as will also come within the easy devising of ordinarily intelligent and skilled mechanics.

The writer is aware that many attempts have been made, from time to time, to produce a solid bearing material in which graphite was used as one of its components. In all of these graphite was claimed to possess self-lubricating qualities, but the small quantity used was, in many of them, not sufficient for satisfactory lubrication, and in several of these attempts an admixture of materials having deficient lubricative qualities, and of materials which are a positive detriment to graphite lubrication has been made. None have, however, by their own showing satisfied the demand of either a mechanical or commercial success.

The use of finely-divided, pure graphite, cemented by materials which of themselves are not favorable to anti-friction, was almost wholly an untried experiment, and, judging from the rough attempts made to secure it, was certainly an unpromising and unsuccessful industry until taken up by Mr. Holmes, who has, in the intervals of a busy life, performed much good and effective work in the making solid, self-sustaining, and thoroughly self-lubricating bearings of these materials.

Mr. Holmes' efforts in this direction have finally taken industrial shape, with great promise in the production of a new and useful material, which has been embodied in patents secured in all the manufacturing countries of the world.

The name applied to this new material is *fibre-graphite*, to which relevancy is given by the fact that it furnishes the most perfect example known of *integral lubrication*—an expression of Dr. Stuart Gwyn's that he employed for describing the effect of a lubricating element which is itself an integral part of the surfaces in contact.

Graphite in a condition of powder and used as a *solid lubricant*, so called to distinguish it from a liquid lubricant, has been found to do well where the latter has failed. All book references to graphite as a lubricant are meant to be the powdered form. Of such Rennie, in 1829, says: "Graphite lessened friction in all cases where it was used." General Morin, at a later date, concluded from experiments that it could be used with advantage under heavy pressures; and Dr. Thurston found it well adapted for use under both light and heavy pressures when mixed with certain oils.

"Tests of graphite made at the Stevens Institute," says the *American Machinist*, thirteen years ago, "demonstrate conclusively that this material, when free from frictional impurities, of the proper quality and properly prepared, approaches nearer the point of perfection for general use than any other lubricant."

There is, indeed, no question today among practical engineers as to the superior efficiency of pure and finely-divided graphite for lubricating purposes, when used with oil through the usual channels established for such methods of lubrication.

Graphite is a native form of carbon, and occurs in fine-grained and foliated masses. It is the purest carbon known next to the diamond, and is capable, as claimed by Dixon, of finer division than any other known substance. It resists the attack of all acids and alkalies, is very incombustible, burns with difficulty even before the blow-pipe, and therefore is much used for melting pots which withstand a great heat. It has a specific gravity about double that of water. It is too soft to strike fire with steel. It has a grayish black color, metallic lustre, is perfectly opaque, and has a greasy feel to the touch. Its unchangeable character and extraordinary smoothness fit it admirably for lubricating purposes.

It is difficult to conceive of the properties of such a material as this solid fibre graphite; we have become so accustomed to the constant necessity of applying lubricants, in some shape or other to all wearing surfaces, that we at once question the possibility of running machinery without them. This material fairly promises to supply the long-wished-for final element necessary to perfect machinery.

Anyone who studies the subject of lubrication will find himself involved in a sea of perplexities; there seems to be no standard for friction, its coefficient varies with every condition of surface, pressure, kind of lubricant, velocity, temperature, and other incidents, nor is it unvarying and continuous even when any selected combination of these elements is maintained.

Metals in moving contact wear rapidly away on the rubbing surfaces, thereby changing the character of those surfaces. The adulteration of oil as a lubricant, in consequence of metallic abrasion, begins at once to lessen its lubricating value. Temperature affects the viscidity and frictional resistance of oils, while constant rubbing robs them of their lubricating qualities. For different pressures and bearing materials employed, oils and grease must be selected according as they are found by experiment to be best suited for each case, and the difficulty of maintaining a standard of quality in any selected lubricant must, in the end, defeat any adopted system, even after elaborate and conclusive experiments.

Volumes have been published and numerous essays written in the interest of oils, oil cups, and methods of oiling. How inexpressibly simple this whole matter will become when the introduction of graphitic lubrication becomes general.

The first requisite for any shaft and metal bearing is that they shall be truly cylindrical, and next that they shall be smooth, with enough difference of diameters only to permit of expansion without seizing contact, and to permit the flow of the lubricant to every part of the frictional surfaces.

During motion, a statement of results may be properly quoted from an address of Prof. Denton, who says: "Interruption of the uniformity of the intervening film of lubricant between the rubbing surfaces is a certain, and probably the far more frequent, direct cause of abrasion."

The "abrasion may result from the gradual and inevitable variations of smoothness due to metallic wear."

This accuracy of fit and finish, and maintained thoroughness of oil supply, are not necessary for fibre-graphite bearings.

The bearing of a shaft to be effective should permit of a certain amount of yielding to the pressure imposed, this idea is conveyed by the original name of "pillow block" which has been given to it; of this quality Prof. Denton says: If the brasses are lined with some of the soft anti-friction metals the crushing down of grooves by a smooth journal does not cause excessive friction. Herein lies the true advantage of these metals. The chances of heating are less with soft, anti-friction metal than with bare brass or hard white metal."

To this valued testimony may be added the deductions of Dr. Dudley, of the Pennsylvania Railway, who says: "Those alloys which may be called softest give the best wear, that is, they lose less metal under the same conditions than harder or more brittle alloys."

Here, again, we have striking correspondencies of character in graphite to meet the wants of frictional contact; notably there exists a yielding surface, the finest granular structure, sufficient tensile strength to support the shaft when turning, and, better than all, the reigning supremacy of effective lubrication.

We have a statement by letter from Mr. Theo. N. Ely, General Superintendent of Motive Power of the Pennsylvania Railway, to the effect that "the wear of the bearings, approximately, is about one pound of metal worn off for every 25,000 miles the bearing goes. The wear of axles is about one third as fast." Introducing other data for comparison of values, a deduction has been reached, which shows the aggregate cost of metal wear of axle journals to be six times the amount of money spent to lubricate them. And again, the cost of the coal burnt for overcoming their friction is double the cost of their lubrication.

When considering the running expenses of any machine, and when considering also the relief to be afforded in the matter of lubrication by the introduction of graphite bearings, we must not center our minds solely upon the cost of, and losses by, the use of oil, but must estimate carefully the power cost and the metal wear and waste from these vital parts of the machine.

On the other hand, the uniformity and permanence of graphite friction qualify it for service in the construction of many instruments and machines, where the element of friction is an important factor in the unfailing performance of the same—as, for instance, in tower clocks, revolving ventilators, aëromotors and machines exposed to sun, air, and dampness, and especially where the same are inaccessible.

All that has been said about the bearings of machines in general will apply with equal force and scope to steam engines, but in these no conclusive experiments have as yet been made. The writer is aware of experiments in the lubrication of steam cylinders and valves of the ordinary construction and adaptation for oil, in which fine graphite was inserted through the ordinary self-feeders to the working parts within, with first-class lubricating effects, in addition to which the joints and the whole interior of the steam apparatus were protected and preserved.

The continued wear of a car axle means rejection of the same in time, if not disaster, and what a sense of relief it would be to feel that the cause of this dangerous weakening is removed to a greater distance or eliminated altogether! Graphite promises this, as has been demonstrated by experiments with ordinary shaft journals.

There are many incidents, more or less serious and expensive in character, which appertain to the location, use and attendance of machinery fitted in the usual way with metallic bearings requiring oil. With many machines and manufactures, cleanliness is not only desirable but essential.

The inventor has run a set of twenty-five cotton spindles, continuously, during a period of nine months, in the usual way, no signs of wear, with either of the bearings or of the spindles. They were run at speeds varying from 9,000 to 10,000 revolutions per minute, and the greatest heat developed at any time was very little above that of the human hand. Tests were made to ascertain the difference in the power required for driving the Rabbeth form of spindle fitted with fibre-graphite bearings, and the same spindle with bearings of metal and supplied with oil. Three persons, at different times and places, made in all 128 tests of each, using an Emerson Power Scale applied to the drum shaft, which directly drives the spindles. The oil used in the Rabbeth spindle was obtained from a New England mill agent, and was given from their own stock of the best used by them.

When used as a step bearing in water upon which a loaded vertical shaft runs, it is proven that 300 pounds may be supported in revolution at 470 turns per minute, upon an obtuse-angled cone two inches in diameter, which is the equivalent of 100 pounds per square inch of surface covered, in which case the tool marks were not all worn out nor any detrimental effect of submersion or abrasion observed after three months of running.

As to the effect of grit, steam and dust in the atmosphere about and around these bearings, the Messrs. Holmes, three years ago, fitted five of them to the shafting in the charging house of their foundry immediately under the coke loft, which must be considered a very trying place to put bearings, but these continue to run satisfactorily without oil, heat, or attention.

A practical machinist in Auburn, Me., says: "Every one of the Holmes boxes that has come under my observation has been a perfect success in the following particulars: They have run dry without heating, they have required no care, they have not worn the shaft, and in sixteen months' trial have not shown any wear themselves."

The overseer of the spinning department of a mill in Lewiston, Me., says "that he had run a spindle fifteen weeks, and during that time he had drawn a new driving cord upon it every morning as hard as a strong man could draw it, and that it had not worn any, but is precisely the same as when he started it. He determines that it has not worn by means of fitting a follower into it that exactly fitted the bushing before it was used. He was amazed that treatment so severe did not destroy it."

The judges of the seventeenth exhibition of the Massachusetts Charitable Association of 1890, held in Boston, "recognize in the Holmes exhibit of lubricant bearings a discovery and invention of almost inestimable importance and value, and one capable of great development.

It being a self-lubricant, its usefulness for all kinds of woolen and cotton machinery cannot be overestimated, not only from the great saving in the use of oil, but as a protection from fire caused by overheated working bearings, as it is impossible to create combustion by the use of this material.

Your committee have devoted much time in looking up the great possibilities for usefulness, and the practicability of this discovery and invention, making careful examination of the material where it has been in practical use for several months, without finding any perceptible alterations in any of its component parts. It is justly entitled to the fullest recognition of the Association. The award is a gold medal."

Another committee of this same exhibition awarded Mr. Holmes a silver medal for his graphite dynamo brushes, which are made of the same materials, but with a somewhat modified treatment.

They have been used on arc and incandescent light dynamos and also on motors for many months. They have also been tested upon a dynamo by one of the board, with satisfactory results.

In the dynamo brush made of this material we have the combination of perfect lubricity and ample electrical conductivity in one solid piece, which may be adapted in form to every requirement of dynamos and electric motors.

The Philadelphia Traction Company have used these bearings under the idler-sheave shafts for supporting their cables in the conduits under the streets. Under date January 13, 1892, Chief Engineer Ely writes: "These are subject to the hardest usage. Part of the time they are submerged in water. They have been in use since last September, and are as good as when first put in. These bearings have not received any special attention."

This bearing material is found to apply as a substitute for copper, for the packing rings of projectiles for rifled cannon. Its importance in this particular will more forcibly appear when the fact is presented that a costly gun is ruined by 200 to 400 discharges.

This rapid destruction of the interior of the gun is due largely to the use of copper rings and grease. The effect of high heat upon iron and steel, with grease in contact, is to corrode them, and the result of the contact of copper with iron or steel, under the excitement of heat and the components of ignited gunpowder, must be detrimental by galvanic action to the smooth and even surface of the grooves in the bore of the gun; as a consequence the copper ring, as a piston, does not fit its cylinder and must therefore permit escape of the gases, producing a violent sand blast against the walls of the bore, which, in addition to the other injurious effects, shortens the life of the gun.

The excellent lubricating and the high refractory qualities of graphite, combined with the tenacity and elasticity of the bonding material in the make-up of these rings by the Holmes method, together with the readiness of graphite to adhere to and to fill the pores of any surface against which it is rubbed, renders the fibre-graphite rings, for this purpose, a material superior to any metal.

This material has been put to the test (under United States Government supervision) in a rifled gun of 3.67-inch diameter of bore, using a 16 pound conical cast-iron projectile. The evidence is conclusive, from careful observation during several tests, that these projectiles were in continued revolution throughout their whole course, the rings filled the grooves, and the interior of the gun was glazed with graphite from end to end.

The writer presents the following conclusions :

With fibre-graphite bearings properly prepared and fitted to the supports and journals of machinery, the cost of oil together with all the appliances necessary to store, retain, convey and conduct the same to the bearings is entirely saved.

During the first revolution of the shaft its concavities are filled with graphitic particles which are worn off the bearing by its rubbing action upon it. When the surface of the shaft is completely covered and evened up upon its whole exterior, the sliding will be conducted thereafter wholly upon the newly-formed graphitic surfaces, to which even the disengaged particles of the bearing will assist in lubrication; friction will, in consequence, be reduced to a minimum, and the shaft jonrnal will be protected from subsequent wearing.

If we start with roundness of shaft and if we grant a certain roughness of surface, the journal after running a short time acquires smoothness by borrowing material from the bearing upon which it runs, and simultaneously fits itself the closer thereto, for its better support and running, after which the motion is all conducted upon the original and upon the acquired graphitic surfaces, with a measure of friction due to the natural lubricity of the graphite used, and without added lubricant of any kind or attention whatever.

The labor of cleaning and oiling, and the cost of waste and wiping are saved, the oil-greasing of fabrics, machinery and buildings cannot happen, and the serious danger of fire from lubricating oils, and the spontaneous combustion of them with discarded waste, are wholly removed.

The making of these bearings, much of it having been done by rude and hastily designed tools and appliances, has amply proven that the cost of them need not be above and may be below the cost of metal ones which they replace, leaving a very fair margin of profit to those who, with superior machinery and appointments, engage to manufacture them, while the user is spared the cost and nuisance of oil and oiling, and in addition thereto is saved much of the cost of renewals as well as the anxiety which ever attends the use of metallic bearing.

A peculiarity of graphite bearings, which may have great value in the arts over the usual materials now employed, where sliding is involved, is that its friction at starting of motion is about the same as its moving friction. This property will enable the engineer to reduce the gross allowances for power to a minimum, when arranging for and providing the machinery of transmission, in cases where graphite replaces the usual metals with lubricants for bearings.

Examples of these graphite bearings have been sent to the editor of INDUSTRY, and may be examined by any one interested.

SAN DIEGO HARBOR.

OTTO VON GELDERN, C. E.

The best harbor for shelter, south of San Francisco, is that of San Diego, near the Mexican boundary. Its geographical position affords certain advantages which will always give it an importance in our Pacific Coast harbors. Situated in an equable climate, where severe storms are almost unknown, and where fogs and heavy rains are rare occurrences, its approaches are easily made as they are free from any danger to navigation.

A narrow sand spit curving in a northwesterly direction toward a prominently projecting headland, Point Loma, encloses a mean tidal area of about twenty-one square miles. The accompanying illustration shows the general shape and location of the bay and inlet.

The throat at Ballast Point is quite narrow, about 1600 feet, and through this contracted gorge, having a profile area of 76,000 square feet, the daily tidal drainage of the habor is discharged with a mean velocity of 2.1 feet per second. With a spring rise of 6 feet, 160,000 cubic feet, or 1,200,000 gallons of water, are forced through this narrow opening per second during a period of 6 hours. These are means only, the maxima being naturally greatly in excess of any of these figures.

This represents a conserving element of some moment, which is sure to preserve a corresponding outlet over the sands that the aggressive waves have piled up around Point Loma. Nature had almost succeeded in closing this lagoon, but the contending physical forces finally reached such a fine precision of balance that an almost stable condition of the mould of the entrance was brought about. In all of the available records of this harbor no change of any extent can be detected. Particularly is this the case in the exterior spits and the approaches.

In a detailed survey, made by the author, in 1887, the bar channel had a width of about 1,000 feet, with a general depth varying from 20 to 21 feet at low tide. Comparing these results with those furnished by a United States coast survey chart made nine years

San Diego Bay.

Showing the entrance to the harbor and its extent; from recent government surveys. The dotted surfaces are sand flats shown to the 24-foot curve at mean low water.

prior, he was astonished to note that the bottom in all that time had undergone no particular change, and that the border line of the outlying peninsula had held its identity — even at the gorge, where the swift currents glide by from tide to tide — and had remained practically unchanged in its configuration since 1879, and probably very much longer.

This factor of stability, due to the uniform action of the wave force and littoral drift, is a point of the utmost advantage to this harbor; it makes the entrance a reliable one, with every indication of remaining so as far as we can look ahead.

The inner bay, although appearing to the eye like an extensive sheet of water ten miles long by one and a half miles wide, becomes, when examined on a hydrographic chart, simply a slough or depression in the sand five to six miles long and reduced to a navigable breadth of less than 2,000 feet. This limited width is an unfavorable characteristic of the bay, for we have here a comparatively narrow channel which must serve as an anchorage for sea-going vessels, and supply all the demands of local traffic. The mid-channel depths vary from 6 to 8 fathoms, the side slopes are quite abrupt and indicate the limit of the extensive sand flats that flank the channel on either side.

The width of the navigable stream retains a remarkable uniformity all the way toward the mouth, the depths increasing as the inner bar, or middle ground, near Ballast Point is approached. This bar is caused by the scouring action of the flood tide, which sweeps along the coast from the southward to the narrow throat, and crowds its waters through it with the regularity of the moon's passage. These waters possess a kinetic energy; they are the boring and disturbing element acting upon the bottom, causing the deep hole found at Ballast Point, with depths of not less than 72 feet. The middle ground, just inside of the mouth, showing depths as shallow as 14 feet, contains the spoil from this pocket. This bar is about half a mile long, 400 to 500 feet wide, and in its position creates two navigable channels, one on either side. The western, along the headland and around Ballast Point, which has been made by the ebb and is constantly used by the outflow, has good depths throughout; but on account of its sudden turn at the entrance is very difficult to make and therefore not used except by deepest draft vessels; the eastern, or straight channel, leads over this bar at its northern end, and at the time the author sounded it, it indicated a shoaling of 19 to 20 feet at low water.

This middle ground is a very objectional feature of the harbor. The only suggestive remedy in this case is that of dredging over it from time to time to maintain navigable depths. An appropriation of $8,000 has been made for that purpose, and a straight channel

500 feet wide, affording a depth of 24 feet at mean low tide, has been created.

Passing Ballast Point the channel leads, in a straight line, to the outer bar, flanked on the west by Point Loma and on the east by Zuninga Shoal, the prominent feature of the sandy cordon that encircles the entrance. The outflow finds its way over the main bar as soon as it has passed the end of the sheltering headland, turning southwestward, or away from the littoral drift, which approaches from the southeast. The depths on this bar, as already stated, are from 20 to 21 feet at mean low tide, in an available channel width of 1,000 feet. (These were the conditions in 1887, but the author feels quite sure that the changes since have been very slight.)

Zuninga Shoal is created by the action of the littoral drift ; it has a gentle slope in the direction of the approach of the wave, from the southeastward, rising to a height of from one to two feet below low water, with quite an abrupt fall on its western line into the channel outlet, which is from six to seven fathoms in depth. The shoal is somewhat disconnected from the North Coronado peninsula by a narrow channel made and maintained by the littoral currents in their sweep along the shore to the gorge of the harbor.

To improve the depths on the main bar by five feet, making it twenty-six feet at mean low water, the U. S. Engineers have proposed a jetty on Zuninga Shoal, about 7,500 feet long, which is to start from a point on the peninsular head near the entrance, and to follow the crest of the shoal toward the outer bar. This structure is to be of brush and stone, and raised to half tide, which, it is thought, while not interfering with the flood, will direct the best portion of the ebb to attack the bar. It is the intention to raise the jetty ultimately above high water.

Such an improvement has been estimated to cost about $400,000. In 1890 Congress appropriated $60,500 for this work, including the dredging of the middle ground. For the construction of the jetty $52,000 are now available, but this limited sum being hardly sufficient to make a fair start, and difficulties having also arisen about the land on the north Coronado head, required by the Government, it will probably be some time before the necessary title to the property is acquired and construction begun.

Under these conditions it is hardly probable that a detailed plan for this work has yet been made. According to certain principles set forth in a previous paper, the author favors the plan of a jetty raised above high water, disconnected from the shore, following the crest of Zuninga Shoal, curving gently toward the bar, to create a gradual reaction, and leading to the existing bar channel in such a manner as to maintain the present direction of the ebb's escape over the bar. A jetty properly placed and aligned should do service in checking the littoral drift ; in allowing full ingress to the flood tide ; and in creating the required reaction to a current directed to the least resisting portion of the bar. Its main duty will begin about three fourths of a mile from the land. If a jetty be built directly from the shore southward, the danger may arise of the intruding flood creating conditions at its sea end, similar to those now existing at Ballast Point ; that is, that a deep hole will be scoured at the jetty end, and the spoil deposited just inside of the present bar, causing another middle ground where there is now deep water.

The conditions of this harbor are in such a peculiar state of balance, that is, the aggressive and conserving elements are so nicely poised, that any attempt at correction will have to be well considered. There seems to be a lack of data regarding currents, both flood and ebb, which should be supplied by making extensive observations in that direction, before projecting a final corrective structure.

When the town of San Diego began to improve and grow with that sudden rapidity known to our Coast, a number of wharves and landing piers were built from the water front of the town to the deep middle channel of the bay. Some of these structures are 2,000 feet long, and were carried on without any regard to the effect of such works on the navigability of the channels. It may be said that as yet no positive proof can be brought that these wharves have ever caused shoaling of the bay ; but, upon the principle that a diminution of the harbor area is certain to cause a weakening of the conserving element, by a reduction of the tidal prism, the engineer has every reason to denounce such a procedure, which is based upon the profit of the individual, without any consideration of the welfare of the whole, and is justified in demanding that all harbor works of that character should be under professional control.

Up to this date no corrective work has ever been attempted, if we except the building of a long dike at the extreme northern end of the harbor, raised for the purpose of diverting the San Diego river from its course, and causing it to empty its waters into False Bay, a shallow outlet to the ocean, six miles north of the end of Point Loma. During flood stages this river brought down a considerable quantity of debris, which it deposited on the extensive flats at its mouth, to the northward and westward of the town of San Diego.

The injuries to the harbor became apparent, and, in order to prevent serious damage, the river was turned.

The first levee was built in 1853–4 at an expenditure of $30,000. This work was carried away by a high water a few years afterwards. The present dike, which is about 6,000 feet long, was completed in 1876, and repaired from time to time as needed. The sum of $82,000 has been appropriated for this purpose, so that with the last appropriation made September 19th, 1890, of $60,500, this harbor has thus far cost the Government $172,500, with an available fund of $52,000 for the jetty work, and an estimated amount of $334,000 additionally required to carry out and complete the proposed project.

Commercial statistics for the year 1890 show that there were 429 incoming and 413 outgoing vessels, with a tonnage of 216,923 and 214,204 respectively. Of general merchandise, 44,251 tons; of coal, 46,226 tons; and of lumber, 32,718,000 feet were brought into the harbor during that year, against 12,000 tons of general merchandise carried away. The revenue collected at the port amounted to $75,703. These figures (taken from the Annual Report, 1891, of the Chief of Engineers, U. S. Army) are a little in excess of similar statistical data for the preceding year, but, as a matter of course, they fall much below those of the years of the so-called boom. During 1888, 647 vessels entered the harbor, bringing of general merchandise 72,468 tons; coal, 108,481 tons; and of lumber, 70,000,000 feet, while the revenue collected amounted to $243,612.

The deepest vessel recorded drew 26 feet; this shows the necessity of waiting for a full tide in order to bring such craft safely into the harbor, and that a bar channel should be created with, at least, 26 feet at mean low water, spring tide. The advantageous geographical location of this harbor, with its strategic possibilities, fully warrant such an improvement of its entrance; and the climatic conditions, together with its sheltered position, are factors that promise to make a properly projected corrective work a success in every way.

THE CONSUMPTION OF SMOKE.*

WILLIAM METCALF, PITTSBURGH, PA.

We have been waiting and watching for a long time for some practical views of the smoke problem. Not declamation against the pollution of the atmosphere, computations of the amount of unburnt carbon, and the depravity of smoke makers generally, but some common sense view of the subject that would be consistent with the failure for thirty years past of all schemes for smoke consuming. Mr. Metcalf's paper meets this requirement. He is one of the owners of a large steel works at Pittsburgh, and the essay given is in the form of a paper read before the Engineer's Society of Western Pennsylvania. Mr. Metcalf said:

"In dealing with a subject of such universal interest as smoke, engineers will pardon me for an elementary statement of the conditions of combustion, which is necessary for the information of any general readers who may wish to read our discussion of the matter.

The combustion of coal involves two processes: 1—The conversion of the carbon to the condition of gas or vapor, and 2—The union of the carbon with the oxygen of the air. This union produces the intense heat so familiar to us all, and the product of combustion when complete is carbonic acid. In addition to this carbonic acid, water is produced by the burning of any hydrogen that may be in the coal. Any sulphur in the coal is burned to sulphurous or sulphuric acid, and any other combustibles are burned to their several oxides.

All of this seems very simple, and it is simple enough until we attack the practical part of it. The difficulty of mixing the gases to produce perfect combustion is so great as to be practically impossible; if we burn all of our carbon to carbonic acid we have inevitably a large excess of air going through our fire, and if we do not burn it all to carbonic acid in a few moments at our disposal in the furnace, there is a deficiency of air, and the excess of carbon is wasted in the form of carbonic oxide, half-burned carbon; or in vaporized carbon, which is thrown off with great rapidity in the dense black vapor which we call smoke.

In the intense heat of a fiercely burning fire our bituminous coal is vaporized with such great rapidity that it is impossible, practically, to burn it all before it flies to the chimney and passes beyond the reach of combustion, but much may be done by steady mechanical firing in small quantities at a time, to reduce the smoke nuisance, where the most intense heat is not necessary, and where other and more important matters do not make other methods of firing imper-

*A paper read before the Engineers' Society of Western Pennsylvania, of Pittsburgh.

ative. A flame of perfect combustion is not white, it is blue, or a bluish white, somewhat of the color of the arc light. Such a flame is not a good radiator of heat and is therefore not so efficient for heating or melting purposes as the cooler white flame of imperfect combustion, which we know as the radiating flame. The carbonic acid, non-radiating flame is excessively destructive; its cutting power on anything with which it comes in contact is amazing, when we see a furnace of the best refractories cut down and ruined in a few hours, which would endure a steel-melting heat for many weeks or months, if it were subjected to a white radiating flame only.

Many of us know, to our heavy cost and intense disgust, how easily a careless or ignorant man can so burn up in a short time hundreds of dollars' worth of the highest refractories, and lay the whole plant idle for repairs. We cannot produce the soft, white, radiating flame without some smoke, because we cannot attain an exact balance of the gases, and therefore to maintain such a flame we must have a deficit of air, a surplus of carbon and some smoke.

In operating a reverberatory furnace for melting, puddling or heating, the smallest loss from the perfect combustion flame is caused by the destruction of the furnace; the furnace contains in its charge of iron, or steel, something of far greater value than the fire brick, and the terrible oxidizing power of that flame can only be realized by those who have to wonder where their iron has gone, and to wonder why their losses in operating are so great and their profits so small.

There is no smoke from a blast furnace, because coke is used, but the vapors of a blast furnace are far more deadly than smoke, only they are white, and so they do not count.

A beautiful illustration of the effects of the two flames we have been discussing may be seen by watching a puddler's operations. When he has scrap balls to cut down to make bottom, he rushes up his fires, pulls his damper wide open and draws in a great surplus of air. In a few minutes the little ends of the scraps grow white, and presently little globules may be seen dropping off here and there. They increase in number and in size until little streams are running down the pile; the whole pile is dripping and fades away to the last little lump, which the puddler pulls out, because it would be a waste of time to cut it down. Melted iron? Not a drop: his furnace is never hot enough to melt wrought iron; it is melted oxide of iron; literally, the iron burned up.

The bottom finished and set, he goes on with the well-known operations of melting and boiling until his iron comes to nature, and how different are his motions. The damper is adjusted to a nicety; a little more fuel is added until there is a surplus of carbon and a deficit of air; he gathers up the little grains and sticks them together into little balls, and these into larger balls, turning them repeatedly, keeping them covered with slag to prevent oxidation from any possible surplus of air or carbonic acid, and so, quickly and carefully, he makes up the balls to the right size and rushes them out of his furnace to the squeezers or hammer. Any oxidation now means loss of iron and consequent loss of wages, and hard toil wasted.

Don't let him make any smoke, though. What matter if his well-earned wages do burn up, provided we may have clear skies, and, I was going to add, pure air? But we will come to that question later. With natural gas the common puddling and heating furnaces do not make much smoke, but the awful waste of gas is a sin, for which Pittsburgh is paying dearly now, and must continue to pay for many years to come. Did we have five years of comparatively smokeless puddling and heating in reverberatories? Then we used up thirty years' supply of the precious fluid in doing it. And some of us are still shooting it up our stacks in the same happy-go-lucky, devil-may-care style.

When we come to the regenerative furnaces one would say, naturally, here at least there is no excuse for smoke. Many of us thought so, and many of us tried it. I have seen hundreds of valuable crucibles cut down, and the furnaces cut down and destroyed, in the beautiful blue-white combustion flame, and yet the steel in the crucibles was not melted properly.

Tons upon tons of iron and steel have been wasted away in the same beautiful flame, and yet the masses were not heated through, nor in condition to be worked. Now, the invariable rule is you must have a smoky stack, and the evidence of a well-run plant is that the stacks do smoke. It is a little odd at first sight, that in these furnaces natural gas makes a little denser smoke than producer gas, but there is nothing singular about it when we reflect that it contains about four times as much carbon as producer gas.

The most persistent smoker is the boiler, and the reason is obvious. There are no hot walls there to radiate back the heat, or to aid combustion. The very object of the boiler is to destroy the fire and rob it of its heat as quickly as possible; therefore every particle of gas that comes unburned into contact with the boiler shell must float up the stack unburned, surplus of air or not, and add to the volume of smoke. The ordinary boiler fire goes through three stages—the freshly fed, when it pours out dense volumes of the blackest smoke and carries what heat there may be up the stack, and there is mighty little steam raised; the good-burning stage, when there is a glorious fire, the boiler steams tremendously, and at dangerous speed, and there is but little smoke; the perfect combustion stage, when there is a beautiful, clear fire, no smoke, and the surplus air is rushing along and carrying off so much heat that the water begins to rise and steam to fall. Then the weary fireman opens his doors, rattles out his ashes, shovels in another cartload of coal, shuts up his doors and lets her smoke, while he sits down to wipe off the sweat, and if he is a sensible fellow, to smoke a little himself.

Why not use producer or water gas and prevent the smoke, even if there is a little excess of air? There is no glowing iron nor delicate steel to cut down here. It has been tried in England, Scotland, Germany, and even among the patient Dutch (how a Dutchwoman does hate smoke and soot). They all gave it up—Dutch and all; and even here in Pittsburgh we tried it at an expense of thousands of dollars, and we thought we had it, but we were all mistaken.

Is there no remedy, then? Yes, a partial one. The first stage can be eliminated entirely by good automatic stokers, but then the second stage of fierce firing cannot be reached, and on the whole probably more boilers would be required. That was the experience 30 years ago with the Meisner grate, probably as good a one as any of the more modern stokers; but that in the end would not be a hardship, because the more moderate and even firing would be so much easier on the boilers that the reduced repair bills would more than balance the interest on the increased cost. But these automatic stokers do smoke just a little, and they keep it up, so that our nuisance is only diulted, not abated. It is not quite so nauseous in attenuated doses, still it must stink in the nostrils of prohibitionists.

With natural gas, boilers may be fired smokelessly when gas is plenty. The favorite way with gas companies is, or was, to furnish two or three pounds of gas, a whole lot of squirt guns called air mixers, a lighted match, and then let her rip. Oh, how delighted they are, or were, with their perfect combustion and their smokeless fires! And oh, how they swore when they saw their big millions of feet consumed and their little piles of dollars received. There are, or were, no meters under the boilers.

The boilers under my charge were rigged that way at first, and the way they roared, and rattled, and vibrated, and perfectly combusted, and didn't make steam was a sight to behold once in a lifetime. And the way I shook and trembled with fear while that was going on was an experience to be endured not more than once in a life. After an expenditure of much time, some thought and considerable money, a partially regenerative fire was adopted by which with from 2½ to 3 ounces of gas we can keep steam up nicely, but singularly, when gas is very low, when every atom seems necessary, then to keep up steam at all we must exclude any surplus air so thoroughly that now our boiler stacks smoke a little—only a little; still, they do smoke; and so the evidence of the best practice again is a little smoke in the stack.

The next thing to consider is, what do we lose by smoke? There are smoke-consuming devices advertised, claiming savings in fuel of from 10 to 25 per cent. The best authorities I know of give the extreme of loss from smoke as 5 per cent., and the mean loss from firing as 2 per cent. Therefore, if the devices mentioned do save from 10 to 25 per cent. of fuel they are misnamed; instead of being called smoke-consumers they should be named heat savers. That such saving over ordinary wasteful methods can be made there is no doubt, and if in doing so they save the 5 per cent. that goes as smoke, and prevent the smoke, so much the better, provided, that in furnace firing they do not burn up ten times this value in iron or steel, or valuable refractories, or all three together.

Some years ago I had the honor to read before this Society a paper on 'Some Wastes of Heat,' showing that an annual loss in this country of some $1,100,000 was fairly divided between wasted fuel and burned iron and steel. Although many improvements have been made since that time, it is probable, judging from the appearance of many stacks, that the same gross loss is going on in the country today. That money would be well worth saving, and it could be and would be saved, if our proprietors could be made to believe that there is such a loss. Through this want of belief the loss continues. It is certain that the best and most economical appliances will produce a minimum of smoke, but not an entire absence of smoke.

Can smoke be prevented by the use of coke? Undoubtedly, if coke can be made without smoke. It would be hard to point out anything dirtier, or nastier, in the way of a smoke nuisance than a coke oven.

But coke is made out in the country, not in the city. Well, is not the country bigger than the city, with more people than the city? Is it not far more beautiful than the city and of much greater value than the city? What is art but a mean imitation of nature, and are we to daub and smear the whole face of nature to save a few puny works of art?

Let us have coke by all means, but first let us have it made without smoke; let us be at least decent to our neighbors while we are being kind to ourselves.

If what has been said is correct, it may be a fair conclusion that some restrictive legislation wisely planned against excessive smoking might be good for the community. On the other hand, it would be equally fair to say that prohibitive legislation would be sure to defeat itself.

Naturally, one would ask here, has science reached its limits? Can no more improvements be made?

By no means; everything is crude now when we study the possibilities of the future.

I will indicate two matters for our younger and more active members to think over: 1, sift the oxygen of the air away from the nitrogen; it is only a mechanical mixture of two gases, and the problem is not insuperable; then with pure oxygen at command, setting aside all other wonders that may be worked, the second problem ought to be more solvable, namely, the direct conversion of the heat of fuel into electricity; that accomplished, the converse would follow as a matter of course, the conversion of electricity into heat; then we should have done with smoke, dirt, ashes, gases and all. But there is a health association after the smokers, and we must consider the question of the health of the community as it is affected by the smoke.

I assert that there is nothing particularly unhealthy about smoke; on the contrary, it may mitigate other and worse evils. A reference to statistics will show that this city is not particularly unhealthy, but that, on the reverse, it enjoys a rather low death rate.

A contemplation of the beautifully clear air of our Atlantic seaboard cities, the most beautiful cities in the world, is apt to fill a Pittsburgher's heart with envy ; but in spite of clear air and balmy sea breezes, those cities are not healthier than we are. Their anthracite coal gives off as much carbonic acid, carbonic oxide, sulphurous acids and other poisons, as it is possible to get from our bituminous coal. Who that has ever inhaled the burning, biting fumes of anthracite, would not infinitely rather have a dose of our blackest smoke? Woe to the weak pulmonary organs that breathe anthracite fumes ; there is no unctuous, protecting coat of soft, pure carbon to save them from torture and destruction. A few years ago none but the most robust could hope to live in our windy, dusty lake cities. Why is it that we hear so little of those terrors now-a-days? There is no difference, except that we have sent them lots of coal, plenty of smoke, and have painted and protected their bronchia and appurtenances with a generous coat of our all-protecting carbon."

CONSCIENTIOUS WORK—A STORY.

In Techno's notes last month were some remarks respecting the building of bad steamers, that recalls the following story of "war times," in this country.

During the most vigorous time of hostilities on the Cumberland and Tennessee Rivers, in the South, the destruction and rebuilding of railway bridges was a considerable part of the operations carried on. The Southern Armies would destroy the bridges and the Northern forces build them up again. In this way there was a great demand for "bridge bolts" or rods, with nuts on each end, and Cincinnati, Ohio, was a principal point for procuring them.

On Front Street in that city was a blacksmith shop, owned by Mr. Charles Graham, an eccentric Scotchman, who in an old tumbledown kind of building had some of the best "screwing tackle" as the English call it, that could be found in this country, or any country. He made square thread screws up to two and a half inches diameter, and furnished to the trade, for all kinds of rough purposes, square thread and various other kinds of screws that other people had to chase on lathes. Over the top of his "cutting shop" was a kind of ventilator, such as is common for the escape of smoke. It was a low room, and we have seen steam coming out of the ventilator, generated by the heat of the dies in cutting large screws.

Graham prepared his own dies, and after they were finished by chasing he would heat and set them "by his eye," for clearance, and then harden them for use. It was a clear case of mechanical genius.

In one case there was instant demand by the military department for about fifty tons of bridge bolts of large size, and the resources of the city were hurriedly called together to see what could be done. The various firms called at the quartermaster's department to submit tenders for what could be furnished, and submit prices. Some firms could furnish one ton a day, some two tons. Each bidder was treated with much courtesy and the bids entered, until it came to Mr. Graham, who was left to the last.

Charley, as he was called, never changed his clothes for business, had no use for a coat in the summer, and wore his hair like his illustrious countryman Carlyle, in the manner of a Scotch terrier. The quartermaster finally turned to him in a patronizing way and said: "My good man, there is such a large quantity of these bolts wanted and in such a hurry that I fear you cannot aid us much, besides your bid is higher in price than the rest, and you do not state how much you can supply."

Graham was offended at this and answered; "My bid is the lowest in the lot. I will not make bridge bolts of the material such as has been tendered for, to please you or any one else. As to quantity. I will agree to prepare and deliver more bolts than all the rest combined, and will have the whole lot ready in four days' time, and done too as these other bidders can not make them."

Graham secured the bolt contract, and remarked to the quartermaster as he went out, "I hold myself personally responsible for the lives of men carried over bridges held by my bolts," and he meant just what he said.

The old blacksmith shop site is now covered by immense buildings, and Charles Graham has no use for the recommendation of his honesty contained in this story.

UP THE BIG SANDY.

BY THE EDITOR.

The Big Sandy River is for the greater part of its length the dividing line between West Virginia and Kentucky. It is navigable for a kind of steamers as far as the "Tug Falls," where a branch of the River by the same name enters the main stream.

The product of the Big Sandy Valley is saw logs of oak and poplar, with hoop poles for trimmings, as the natives would say. There is no other industry carried on, or was not in 1852, of which period the present is written. We went up the river then with a party in search of timber, and the impressions and observations gained in boyhood have lasted vividly ever since.

We waited a day in Catlettsburg, at the mouth of the river, until the little steamer got ready to go up, and took passage. This example of marine architecture was about 75 feet long, a "stern wheeler" of the most primitive and shaky type, but the boat, as a curiosity, was overshadowed by the passengers of which we had some warning before starting, but the fact was much greater than the warning. It was a revelation.

These passengers were raftsmen returning home after having floated their timber down to Catlettsburg, where it was sold to speculators who came up from Cincinnati and other points to purchase. We had seen a good deal of frontier matters and rough life of one kind or another, but had never before met with people such as traveled on that little steamer, and we doubt if a match for them could be found in any civilized, or half civilized, country in the world.

Coming down to Catlettsburg was the event of their lives. They brought down timber, and took back bacon, whiskey, tobacco, powder and lead, with other indispensables to last for a season. They were clad in all sorts of uncouth raiment; out, as they said, on a "general tear," and so it proved. There was no danger to person or property, from these Big Sandy people. Except making some peculiar money of their own, up in the fastness of the mountains, crime was almost unknown. The coin made was called "Sprinkle money," from the name of a German artisan who conducted the industry, and the Big Sandians claimed it was good money — a good deal better than Government money, because it "contained glass and was harder."

When the boat started there began an onslaught on the little bar, where there seemed to be but one kind of drink, "rectified corn whiskey." The tumblers used were small ones containing about a gill, or perhaps less, and these were filled up at each drink. The glass was put to the drinker's lips, his head thrown back, and down the whole went at a gulp. In an hour or two after starting, the company became boisterous, and finding a "fiddle" on board a dance in the cabin of the boat was proposed.

Such a dance I have never seen elsewhere, not even among the negroes of the plantations. In a few minutes one of the men had stamped through the deck, splintering the thin pine floor as though it were paper. The captain came down from the pilot house to expostulate, but was informed that unless he left "he would be licked in about two minutes." He left, and the deck was kicked through in a number of places. There was continuous swearing, a din of noise, and "horse play," but no fighting.

It was a night of horror to us tenderfeet, but no accident happened, and in the morning we were at the "Falls of Tug," where there was a hotel for timber buyers who frequently went up that far. This house was another wonder. It was neat and commodious; presided over by a lady, a large, queenly looking woman, an educated Virginian, who, amid her savage surrounding, reminded one of Rider Haggard's "She." Her voice was strong, musical and commanding, and it was marvelous to see her influence over these rough people. We wondered why she staid there, and yet believe that some strange history connected with, or had preceded, this experience of hers at the "Falls of Tug."

The next day, after breakfast, we went out to look over the country. This too, was marvelous. There was not a square rod of level land. The steep hills run down to the water like the sides of a V flume. The roads were trails, or "troughs," and no wheel carriages of any kind are used in that country. In collecting logs they are dragged, or "snaked," as it is called, in ditches partially filled with water or soft mud, a little like our timber flumes on this Coast, except formed by a ditch in the earth. The mud gave some buoyancy so the oxen could drag a log that would be immovable on dry land.

These trails, or ditches, converged on what were called "chutes," places far above the river where the logs could be shot down into the water, not endwise but rolled. It was a grand sight to see an oak log, twenty feet long and two feet in diameter, nearly as heavy as water, start down one of these steep inclines. It gathered velocity until it would spin like a top, and then plunged into the river throwing the spray fifty feet high. Small timber near the chute did not need clearing away, the logs did that. Many of the oak logs sink in the water, and in making up rafts poplar ones are put among the oak to render the raft, as a whole, buoyant.

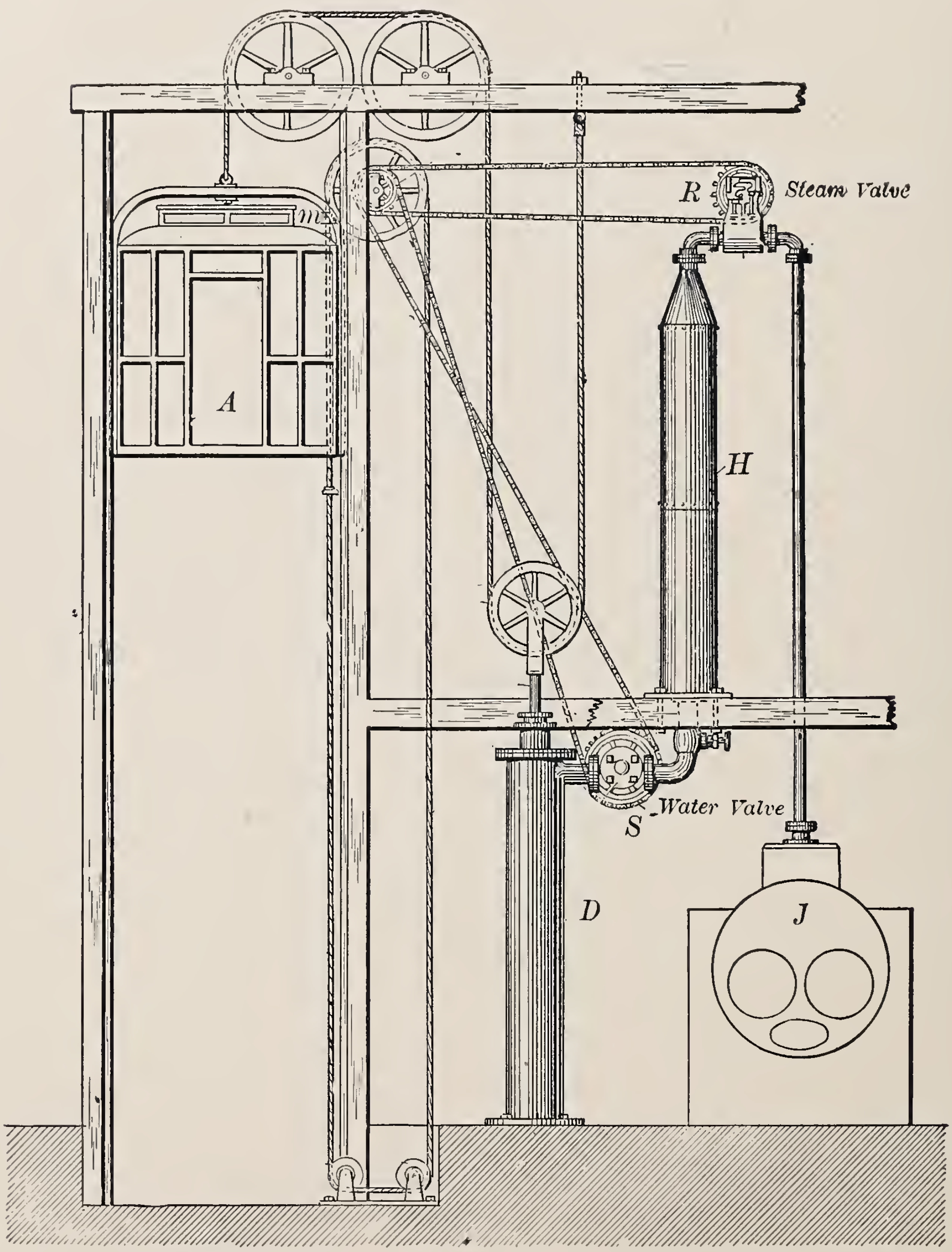
There are tremendous freshets in these West Virginia Mountains, and in collecting logs they are shot down into "ravines" with full confidence of their being washed out, if not the first year, then at some other time. Occasionally the poplar logs are lost by rotting, sometimes oak also, but this requires four or five years of exposure. The "sap" is destroyed in a year or so if in a damp place, but that is no detriment. The sap is thin and worthless even when sound.

When we were ready to descend the river there was no boat. It had been taken off for repairs, or sunk, at any rate it did not come up to "Tug," and we bought a skiff to go down the river in. It was high water, running at 7 to 8 miles an hour, and the journey down was rapid and of much interest. My friend and self were expert oarsmen, "raised to the water" as the people call it, and we made about twelve miles an hour, reaching Catlettsburg in six to seven hours. Here we had a fine boat of our own brought up on an Ohio River steamer, and, after resting one night, we started down the Ohio, on a swift current, pulling sixty miles without stopping a single stroke.

The "water craft" learned in these rapid streams is more intricate than that of the sea coast, or in the lakes. There is not the danger of storms; but instead there are dangers of a serious kind. To be "dumped out" in a rapid current filled with obstructions is certain death to anyone without presence of mind and a good swimmer. The temperature of the water during winter is near the freezing point, and soon chills one when in the water.

"Running out rafts" on the crooked mountain streams is an exciting and dangerous business, calling for strength, coolness and bravery. If a raft strikes it is at once torn to pieces. Its course in the water is one of the mysteries of navigation. When a stream is navigable and has dams, chutes are provided for the rafts to go over the dams, the same as boats shoot the rapids at Lachine Falls in the St. Lawrence near Montreal. I have gone over these rapids several times, and pronounce it child's play in comparison to a raft on the Upper Alleghany, Big Sandy, or Kanawha Rivers.

Forty years has produced marvellous changes in this mountain country of West Virginia. The railways have altered everything. The Sprinkle money factory has become a tradition.



BALANCED HYDRO-STEAM ELEVATOR.

BALANCED HYDRO-STEAM ELEVATORS.

MESSRS. CAHILL & HALL, SAN FRANCISCO.

We have several times in INDUSTRY noticed what is called the hydro-steam system of operating elevators, introduced in this City about two years ago by the firm above named. The last time attention was called to a high speed ram or direct elevator for passengers in the Phelan building in this City, and of the removal of the counter-weights that had previously been used, because they could not be moved at 300 feet per minute, the rate of the new elevator referred to.

To avoid the losses due to the want of such counter weights, and save the expense of providing them, Messrs. Cahill & Hall have now arranged their machinery, so as to balance the cage with the water displaced on the descent of the cage.

This method of balancing is applicable to either a direct or ram elevator in which the piston is placed beneath the cage and moves the same distance, or to one having multiplying gearing between the cage and piston so the stroke of the latter can be reduced to any desirable limit.

The diagram opposite shows the method of securing this balanced action without the use of counter-weights when elevators are operated on the hydro-steam system. The posts, cage, pulleys, and other of the common details will be understood without description. The main, or water, cylinder *D* is of the usual construction, having at its top a valve *S* opening to the receiver, or steam vessel *H*. When the cage *A* is at the bottom, and the piston in the cylinder *D* is at the top, the water is forced into the receiver *H*.

For ascent the steam valve *R*, communicating with the boiler *J*, and also the water valve *S* between the cylinder and receiver, are opened. Steam rushes into the receiver *H*, driving the water from that vessel into the cylinder *D*, forcing the piston down, and raising the cage. For the return stroke the steam valve at *R* is opened to the atmosphere, permitting the steam in the receiver to escape, and the weight of the cage expels the water from the main cylinder *D* up into the receiver *H*. This operation seems a very simple matter, but it is by no means so, as will be presently explained.

It will be noticed that the receiver *H* is set at a higher position than the main cylinder *D*. This higher position is so chosen or arranged that the water driven up into the receiver *H* balances the the cage *A* to any desired extent, and as the water rises and falls in the receiver in proportion to the movement of the cage *A*, the balancing load is constant, the same as if a weight and pulleys were employed for that purpose. In this manner the functions of a counterbalance are included in the operating apparatus, in a controllable manner, without any additional expense, except it be in setting the receiver at a higher position than is usual.

In the simultaneous movement of the steam and water valves before mentioned, there is required a special construction of the latter that forms the subject of some important inventions by Mr. Hall, of the Company. For example, if these valves, for steam and water, are opened simultaneously, the pressure in the main cylinder *D* will be, at that instant, the same as the pressure in the receiver *H;* and if greater or less than the load on the elevator the cage would suddenly move up, or down, until an equilibrium was established between the two vessels. This is undesirable and dangerous, in fact renders simultaneous steam and water valves of the common kind impracticable. The water valves are therefore made so that when opened in either direction the outlets, or ports of the valve, remain closed to flow in a direction "opposite to the one intended," by means of hinged automatic covers. As soon as there is an equilibrium of pressure, or a slight preponderance of pressure, in the direction of the desired flow, the hinged valves open and permit the water to pass into or out of the main cylinder as desired.

These water controlling valves can be described as forming a positive stop valve when in their central or neutral position, and when opened either way permitting flow only in the direction intended, preventing reaction, or back flow, and consequently guarding against all false movements of the cage in ascending, or descending, by a change of the load, or pressure, in the receiver *H.* Such change of relative pressure between the two vessels is continually occurring, by changing the load, condensation of steam in the receiver, leaks of the valves, and other causes.

The condensation of steam in the receivers has in practice proved to cause no loss worth considering, so long as there is no agitation of the water, and the dynamic duty of a given quantity of steam is greater than that of the same amount of steam applied through expansive pumping apparatus; also that the consumption of steam is in proportion to the duty performed,

THE LONDON ELECTRIC SUPPLY COMPANY.

A recent meeting of the shareholders in the London Electric Supply Company has brought out, in an accurate way, the principal facts connected with this scheme, the most gigantic and bold that has ever been ventured upon the field of electricity. The *Engineer*, London, commenting on the scheme says: "the scheme was marked by the audacity of genius," and had it not been for a series of mishaps, that came near wrecking the company, it would have placed Mr. Ferranti at the head of electrical engineers, and stood without anything that could bear the name of rival.

The dimensions of the dynamos, the enormous voltage, and means of transmission, have been so often described that we need only remark that the pressure was to be 10,000 volts, and one of the armatures 40 feet diameter and of 10,000 horse power.

The conducting mains, which were hollow shells, or tubes, one inside the other with insulation between, were laid on the line of the South Eastern Railway, and the effect was to upset the telegraphic service by the railway company's lines as far as Paris. This caused delay, but was finally remedied by Mr. Ferranti, and then the Grosvenor galley-distributing stations in London were burned with a great loss of apparatus and the destruction of nearly the whole system of transformers, both for the first reduction from 10,000 to 2,500, at the distributing station, and those for final distribution from 2,500 to 100 and 200 volts, for consumer's use. The main generating station was at Deptford, a suburb on the Thames below London, where land and supplies were cheap.

The total horse power thus far applied has been 4,500, and at that, found far in excess of an economical limit for a central station, because of the variation in consumption. The present chairman, or president, as we would say, of the company, said that the great 10,000 horse power unit is years ahead of its time, and that it would require 250,000 lights to consume the product. Mr. Ferranti's principal mistake came from counting on several hours of maximum consumption every night, whereas it is only for a short time, not exceeding half an hour, consequently an enormous generator working to its capacity for a few minutes each day must be wasteful machine.

The fact is that the subdivision of generating stations is one of the latest principles to be understood and brought within economic rules. The chairman, at the meeting above named, stated that 1,000 horse power was a limit for large plants and 500 horse power for small plants, which is, no doubt, farther than most engineers would go in a similar estimate at this day. The Company are at present operating their mains at 10,000 volts, and are fast settling down to what may be called a normal basis of business, that is successfully and rapidly extending.

COMMUNICATIONS.

EDITOR INDUSTRY.—*Dear Sir:* In your issue of May, page 402, appears a criticism on the work done by a Dodd Sigmoidal Water Wheel at the Keystone Mine, in the course of which you point out "that the measured amount of water does not agree with the discharge of two nozzles of 1.3 inches bore, and as nozzle discharge is a tolerable accurate measure of volume, etc."

As you do not state what the amount of water discharged should have been, and using the phrase "tolerable accurate measure," etc., may we not infer that you do not know with any degree of certainty what the discharge should be?

Our inference is strengthened by the fact, that in the issue of INDUSTRY of April, 1889, page 135, "Flow of Water," you publish from the *Engineering News* the result of some experiments on the flow of water, which tends to show that velocity does not equal $\sqrt{2gH}$, and that in practice this formula is in excess of the truth by nearly twenty-five per cent.

In commenting upon this you say, "It seems strange that the flow of liquids, a matter so easily determined by experiment, should remain unknown, or at least unsettled."

We have every reason to believe that the water used on this wheel was properly and accurately measured, as we are informed that it was measured repeatedly, at different times and by different persons, but always with the same result, and we may point out as a significant fact (or coincident, if you please) that the measured discharge from these nozzles corresponds almost exactly with the results obtained from the experiments mentioned in the article referred to above.

"Nozzle discharge" has not yet been settled to a greater degree of exactness than you have mentioned, viz: "tolerably accurate," which may be translated commercially as "fair to middling."

Our experience with this subject has been that there "are nozzles and nozzles," and as St. Paul remarked to the Corinthians, "One star differeth from another star in glory," so the discharge from one nozzle differeth from the discharge of another nozzle, and without knowing something of the construction of a nozzle no one can criticise its discharge with even "tolerable" accuracy.

As to the efficiency attained by the wheel, there is nothing phenomenal about it. As well call it phenomenal when the pitcher in a baseball team "gathers in a hot one" straight from the bat. He simply takes up all the energy contained in the ball, bringing it to a standstill, and these wheels, when properly constructed and run at the right speed, will convert *all* the energy contained in the water into useful work, with the exception of such losses as are due:

1st. To skin friction in the buckets.

2d. To disturbance of the stream due to the buckets rotating through it.

3d. To journal friction and resistance of the air, of the wheel itself.

When these wheels have been carefully analyzed and scientifically considered, the "phenomenal" will quickly disappear.

Respectfully yours,

San Francisco, May 23, 1892. W. G. Dodd.

To the Editor of Industry:

Sir: In your notice of Prof. M. C. Ihlseng's new work "*A Manual of Mining*," you mention my hydraulic pumping engines and his remarks thereon.

You are quite right in respect to there being none of my engines in use in the Comstock Mines. None have ever been erected there, and Prof. Ihlseng is mistaken.

As to concussion, my engines are operated by common sheet iron pipes, which withstand all the shocks the engines produce. The one at the Wildman Mine, for example, has been running since 1887, and is now pumping from a depth of 900 feet. The engine takes its water from a pipe 15 inches diameter, made of No. 12 iron, sustaining a head of 450 feet, or a pressure of nearly 200 pounds per inch, which shows there can be no water shock such as is mentioned in the "Manual of Mining."

I am aware that but little is known of these engines, or the principle on which they operate, and consequently, am not much astonished at Prof. Ihlseng's conclusions.

Yours very truly,

Sutter Creek, Amador Co., May 16, 1892. S. N. Knight.

To this letter we will add that it is a misfortune both to Mr. Knight and the mining industry, not to say the hydraulic industry of the world, that he has not more widely explained the action of his hydraulic engines. Some description and explanation of their method of operating will be found in No. 21 of Industry for April, 1890, and we are at this time urging Mr. Knight to contribute a paper on the subject, to be read before the Technical Society of the Pacific Coast, during the coming Summer.

MACHINE DESIGN.

We mentioned in connection with Professor John E. Sweet's letter in the May number of this Magazine, that Professor Albert W. Smith, of the University of Wisconsin, had also written in explanation of a department of "machine design" and his connection therewith. Professor Smith brings to his aid an experience, that is to say the least, exceptional among teachers. In the Register of the University of Wisconsin for 1892 we find the following set down in a notice of the professors there:

"Professor Albert W. Smith B. M. E., Cornell University, 1878; machinist and contractor with Brown & Sharpe Manf. Co., Providence, R. I., 1879–80; machinist and shop foreman, Straight Line Engine works, Syracuse, N. Y., 1880–83; superintendent Kingsford Foundry and Machine Works, Oswego, N. Y., 1883–86; M. E., Cornell, 1886; fellowship, Cornell, 1886–7; assistant professor of Mechanical Engineering, Cornell University; 1887–91; professor of Machine Design, U. W., 1891; Mem. Amer. Soc. M. E., Mem. Western Soc. Eng."

In the list of engineering studies under the head of "Machine Design" is named "graphic statics, machine elements and applications to complete machines." Prof. Smith in his letter says, "he believes that much can be taught helpful to young men as a start in the right direction toward machine designing, also that he is aware of the futility of teaching machine design by mathematical rules that ignore considerations of manufacture, which modify the whole problem." This much we gladly concede and can only find fault that Professor Smith did not qualify, in some manner, the announcement on which our first remarks were based. One passage in his communication sounds so much like his old instructor Prof. Sweet that we can not forbear quoting it. He says: "Now there are hundreds of men in practical life, who, I have no doubt, would make better teachers than I; but they wont." Professor Sweet says he does not know that his company makes the best steam engines, but of one thing he is sure, they make them as well as they know how, and this seems to be the very reasonable position of Professor Smith, respecting machine design. We wish him a full measure of success at the Stanford University, and will promise that our practice here, where there is almost no "manufacturing" of machine work, and where nearly everything is designed when constructed, will furnish something to commend and much to condemn, but all things considered, designs for special work that will compare with that found elsewhere in the country.

ECUADOR AS A MINING COUNTRY.

The Bureau of the American Republics, in its *Hand Book*, says of Ecuador:

"Ecuador, so called from its situation on the equator, is bounded on the north by Colombia, on the south by Peru, on the west by the Pacific Ocean, and on the east by Brazil. The climate is varied. On the coast it is hot, and as the country rises the climate varies, until at last, at the height of 11,000 feet, perpetual snow is reached. The cultivated lands lie chiefly in the valleys of Quito, Ambato, and Cuenca, where reigns perpetual spring. Ecuador is rich in natural resources, but agriculture is in a somewhat backward condition, and its great mineral wealth is for the most part undeveloped, owing to the lack of transportation facilities."

The most reliable current information respecting gold mines in Ecuador that can be referred to is an article in the May number of the *Engineering Magazine*, contributed by Mr. R. F. Lord, C. E., who has recently visited and examined a considerable area of the auriferous fields of that country.

As Mr. Lord's report is not to induce investment, it will command confidence, and it certainly indicates great promise of profitable placer working over a large district, so favorable, indeed, that it will excite surprise on this Coast, where people are supposed to keep a keen watch upon all opportunities for placer operations. The gravel immediately available is placed at 43,000,000 cubic yards, and the gold at 60 to 65 cents per cubic yard.

What will most surprise people in Mr. Lord's report is the very favorable physical and geographical features of the country, which seem to invite mining operations. Our space will not permit extracts, and the descriptions are too wide for a synopsis, so we must refer our readers to the report, or a portion of it, which makes up the article at first referred to.

As no mention is made of the source of the gold, we may infer that there is to follow the explorations and development of quartz mining in Ecuador, at any rate there is a probability of the country coming into prominence, in the near future, as a gold producing one of considerable rank.

THE MECHANICAL ENGINEERS AT SACRAMENTO.

A principal and pleasing fact in the late visit of the American Society of Mechanical Engineers to this Coast, was their reception at Sacramento.

We will not attempt a notice of all that was done, but mention only a fine "shop souvenir" in illuminated text, prepared by the mechanics, and presented to each of the visitors. Besides greetings, this souvenir contains the following facts respecting the Sacramento works, which will have interest to all of our readers:

"Here are located the main shops of the Southern Pacific Company, which cover an area of 42 acres, of which 17 acres are occupied by buildings, employing from 1,800 to 2,000 men continually, with a monthly pay roll of 125,000 dollars. These shops are principally devoted to the maintenance and rebuilding of rolling stock of the 4,500 miles of railroad constituting the Pacific System of the Company, consisting of 731 locomotives, 931 passenger train cars, and 15,712 freight and miscellaneous cars, also the general repair work of the floating equipment of the Company, consisting of 26 ferry and river steamers, tugs and barges. The works are conveniently arranged for the rapid and systematic production of the different classes of work. The machine shop is well equipped, and has a traveling crane capable of lifting the heaviest locomotive. The forge shop has a 30-ton jib crane, numerous steam hammers, and can handle forgings up to 20 tons in weight. The output of axles ranges from 40 to 50 per day.

Here are also produced the steel brake beams used on the road, which are forged from old steel rails. The rolling mills have an annual production of 12,000 tons. The wheel foundry has a capacity of 300 wheels per day, and the average daily melt of the cupolas is about 60 tons. In the car shops, constructions, repairs, painting, and upholstering for all classes of railway cars are well provided for. The forests of California, Oregon and Washington furnish the supply of lumber used here. The paint shop has a capacity for handling 21 passenger cars and 8 large Pullmans. In addition to general railway repair work the output of these shops for 1891 was as follows:

Chilled car wheels, 29,854; rolled iron, 19,753,997 pounds; iron castings, 8,154,878 pounds; brass castings, 265,295 pounds; journal bearings, 241,764 pounds; phosphor bronze castings, 40,746 pounds; Babbitt, 284,374 pounds; track spikes, 2,460,900 pounds; track bolts, 627,596 pounds; nuts, 677,377 pounds; angle plates for track, 3,981,668 pounds. Of new work there was built in late years some 63 locomotives, ranging from 8-wheeled passenger to 14-wheeled or Decapod locomotives.

The building of cars for last year was 547 new freight cars of 30 tons capacity, to replace worn out small capacity cars. Everything used in the construction of this new work was manufactured at the Sacramento shops."

A NEW TEST IN METROLOGY.

The following account of the execution in Pittsburgh of a most difficult scientific work, appeared some time ago in a newspaper, and is reprinted here from the *Ohio Valley Manufacturer.* It is to be regretted that the explanation is no more complete, but the "fact" alone is one of great interest.

"There has just been completed at the works of Mr. J. A. Brashear, the most difficult and accurate piece of apparatus ever made by human hands.

To give the reader an idea of this piece of work it is necessary to state just what it was made for. There is at Breuteil, near Paris, France, a building in which the standard meter of fourteen different nations is kept. This meter is called the standard meter of the international bureau of weights and measures, the bureau being composed of representatives from fourteen nations, the United States, Great Britain, France, Germany, and Switzerland being among them. It is generally known that the French meter is based upon the measurement of an arc on the earth's surface, and was intended to be one ten-millionth of a quadrant of the earth's circumference. The measurement is now known to be in error, but the amount of error when brought down to a meter in length is, of course, a very small factor. Many attempts have been made to get the absolute value of this meter, and its errors are now known within a very minute quantity, but it has been desirable to obtain its value in something more readily measured than an arc of the earth's meridian something imperishable and that can be referred to at once in case of the destruction of the standard meter.

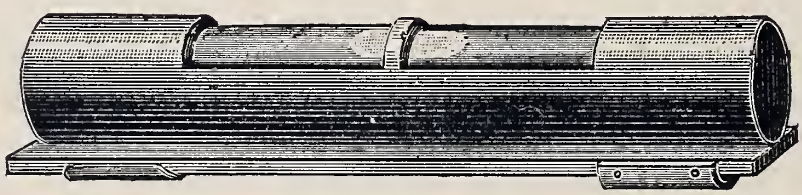
An American physicist proposed as a basis of measurement a wave of light, which is of absolutely constant length and will remain so as long as the solar system remains in the luminiferous ether. Now, the difficulty was in first determining the value of a standard wave length, and then applying this method to the determination of the value of meter in terms of light waves. The theory of the method was fully worked out by Prof. Albert A. Michelson, whose measurement of the velocity of light is now recognized as the most accurate of all the determinations yet made.

The next step was to get the optical parts of the apparatus, as well as the mechanical devices made. Prof. Michelson tried in vain to have it made in Europe.

A year ago he applied to Mr. Brashear to undertake the task, the requirements being such that an error of one-millionth of an inch was the limit allowed. The instrument was completed and has been tested so thoroughly and so satisfactorily that Prof. Michelson has unhesitatingly stated, that the accuracy of the optical surfaces was greater than he demanded.

The International Bureau of Weights and Measures at the last meeting concluded to adapt this method of Prof. Michelson's to the study of the standard meter, and instructed the committee from the United States to have the most difficult piece of work made by Mr. Brashear. His part of the work has now been completed. There are twenty glass plates whose error is less than one-millionth of an inch, and five plates whose error is perhaps much less. Indeed, so sensitive are these plates to changes of temperature that they must have the most perfect environments of an equal temperature, so that they may be studied, and even then it requires many nights of careful study to know the results of half an hour's work.

It is certainly to the credit of our townsman that this difficult work should come to him, unsolicited from such a source. Dr. Hastings of Yale says it could not have been done any where else in the world, and Prof. Michelson agrees with him fully."



DETACHABLE TAPE-LINE LEVEL.

Mr. Ernest McCullough, C. E., of this City, has devised an implement, shown above, which is strictly of the common sense class. It is a neat little spirit level, weighing less than one ounce, arranged to fasten on a tape line in measuring horizontal distances.

On the bottom of the base plate are spring hooks that slip over the tape so the level can be put on or removed instantly, and when not in use can be carried in the pocket the same as a pencil or pocket knife. One can be applied at each end of a line if required, and a little observation enables allowance to be made for deflection.

Of the use and value of the instrument nothing need be said. Any engineer will see at a glance its objects and value in practice. The instruments are now in use by a number of engineers here on this Coast, all of whom are much pleased with the convenience, and the accuracy of surveying and measuring performed by its aid. The price is only $1.50.

AN IMPORTANT ENGINEERING WORK IN JAPAN.

The Pelton Water Wheel Company, of this City, send the following :

The last mail from the Orient brings a very interesting account of the completion and successful operation of a great government work in Japan. Lake Biwa, having an area of 500 square miles, is situated seven miles from the City of Tokio, and at an elevation of 143 feet.

A navigable canal has been cut from this lake to Tokio, involving two miles of tunnel and an aqueduct of considerable length. At the eastern extremity of the city, to which point the canal has been brought, there is a sharp decline of 118 feet, from the base of which the canal is continued to the sea, The difference in level is overcome by inclined plane ways 2,100 feet in length, on which boats are raised and lowered from one canal to the other. These ways are operated by electric power furnished from a Pelton Water Wheel connected with a Sprague motor.

The fall above named affords also a very valuable water power ; a part of which has already been utilized for various mechanical purposes by means of electric transmission. The power station is situated at the foot of the incline, and consists of three 8-foot and two 6-foot Pelton wheels, aggregating about 600 horse power, which are supplied with water from the high level canal by three lines of 36-inch pipe, 1,300 feet in length, delivering water to the wheels under a head of about 100 feet.

These wheels are at present operating three Edison dynamos of eighty kilowatts each, the power from which is distributed about the city within a radius of two miles, running rice mills, spinning mills, a watch factory, and various other machinery. One Thomson-Houston alternating current dynamo of 2,000 volts supplies the city with 1,300 incandescent lights, as well as many arc lights.

The above works — involving an expenditure of $1,250,000 — were planned by, and executed under the direct supervision of Mr. S. Tanabe, an eminent Japanese engineer, and their operation is said to be a great success, both from a mechanical and financial point of view.

SCREW PROPELLERS.

Mr. Alexander Vogelsang, an European engineer, who has given much attention to screw propellers, and has himself made important improvements in them, says, in a recent article in the *Engineer*, London, "The best cure for those who believe in 'rotary race,' 'vacuums,' 'rarefactions and vortices,' is to take a trip to Queenstown, and observe a propeller of over 17 feet diameter, going at half speed. The water is usually so clear that the action of a propeller at such reduced speed can be clearly seen. They will, to their surprise, hardly discern any motion in the water whatever. When the propeller rotates at full speed, the displacing action of the blades disturbs the water to such an extent that everything becomes confusion."

On this Coast, especially to the southward, the water is, in the summer, clear enough to see the action of a propeller, and as mathematical treatment has not settled the problem, a good deal may be learned by observation of the kind above noted. If a station were made out over the wake with a hood to cover the observer, and shut out vertical and horizontal rays of light, the action of a screw might be observed in this manner, supposing that the disturbed water turned white, as it does near the surface.

Prof. D. E. Hughes, of Irvington, California, in a recent letter to the editor, intimated an intention of some observations on propellers which it is trusted he will carry out, and if so, in any manner to observe their action, we imagine he will find that the writer just quoted is in error, if the propellers are "adapted" for full speed, and not for half speed; also, that the speed of a ship, or the rate of forward progress, is the chief factor in securing still water, or undisturbed water, behind the blades.

It may be that disturbance around the boss, or within a certain distance of the center, may increase with the speed of a ship, but not for the effective areas acted upon by the vanes.

FRANCO-PRUSSIAN GUNS.

There has arisen a new Franco-German war, in which the heaviest weapons are employed, but it is harmless in so far as life and property. The active weapons are pens, and the point of contention the difference between Krupp and Canet rifle guns. The result, so far as can now be predicted, will be the opposite of the first war, because the French have certainly the best of it this far. It is common to concede to France a supremacy in certain manufactures and arts where taste and precision are ruling factors, but here we have a wonderful development of one of the heavy arts by Messrs. Canet, at Havre. There is also, in the present contest, an advantage of cool, careful statements that are somewhat unusual with our Latin friends when national attainments are the theme.

It is not commonly considered that the construction of modern guns, and their merits, is narrowed down to making a strong "containing vessel, or tube, that will sustain an internal pressure of 15 to 20 tons per square inch. It is true that length, rifling, powder and other factors enter into the problem, but the main thing is strength against rupture, and this affords a fair field and a fine one for competition. It is a problem of skill in preparing material, and methods of putting it together.

In this country we can expect, or indeed have attained, a fair proficiency in the art, rendered necessary by that barbarian element that lingers in modern civilization, or what we call civilization, the desire to settle international questions by killing people and destroying property.

We will not trouble our readers with statistics, or "quantities," in the contest going on, further than to say that the most wonderful part is the methods for determining the merits of guns. The pressure, velocity of shot, penetration, and indeed all that pertains to gunnery, has been resolved into an exact science; at least in so far as the dynamical part and problems now are confined to the nature of material for shot, and the method of building up guns so as to utilize the whole strength of their walls when stretched from the inside, and subjected to high tension, with sudden changes of temperature.

THE STANFORD LOAN SCHEME.

The *Century*, for October 1891, in summing up the money articles published during the year, mentions the attempted establishment of a "land bank" in England in 1696, nearly 200 years ago, corresponding in all essential features with the proposed mortgage banking or lending proposition of Senator Stanford. The capital was to have been £1,300,000. The King subscribed £5,000 to start the list, but at the end of the time the whole amount subscribed was only £21,000. The land owners did not want shares. They wanted to borrow instead of invest, and capitalists knew better than to lend money on this kind of security, because it would lower the rates of interest.

In Rhode Island, between 1790 to 1800, there was established a "state land bank" having all the features, financially, of the Stanford scheme. This lasted five years, and at the end of that time the shares were worth about seven cents on a dollar.

Leaving here, the *Century's* history and its opinions, we will suggest that the popular idea of mortgage securities is wrong, and that land does not, as is commonly supposed, form a reliable basis on which such credits can be issued. It is tangible property that cannot be destroyed or concealed, and that is all.

The fluctuations of value are erratic and uncertain, more so than with any staple commodity of commerce, while, in many states, its tenure or ownership is the most uncertain of all kinds of property. There is a quasi ownership by the Government, much stronger too than people suppose, as may appear in the near future, and, in some sections, titles, as we know here in California, are uncertain enough to require insurance, the same as fire risks. There is also the formidable objection of foreclosure in case of default, a proceeding so distasteful, in the case of homes, that even money lenders dread such a proceeding.

There is no need, however, of arguing the scheme of national loans on ethical grounds. This, and all others of the kind are too commonly for personal ends, and may be treated with the German adage, *Da liegt der hund begraben.* Senator Stanford's active life, and əw say it in no disparagement, has been spent in getting money out of the National Treasury and out of the public, which is the same thing, not for the farmers but for himself, and his concern for any class of community may well be scanned in every way before it is accepted as philanthropy.

That the Government can lend money at a lower rate than people can, is not in the nature of things true or possible. The safeguards thrown around loans, and the machinery of assurance, as it may be called, is expensive, and of this the Government would need a good deal more than a bank or money lender. The cost of this assurance, such as proofs of title, must be added to the rate of interest. All this is, however, well known, and need not be gone over here.

An explanation of this land mortgage loan scheme, that we have not seen, is this: Senator Stanford, for many years past, has seen vast sums of money extracted from public sources. His conception of wealth is that it comes by chance and he does not see why the farmers, who are now so sorely pressed, should not benefit themselves by methods which have proven successful in other cases.

MONEY, WEALTH, GOLD, BALANCE OF TRADE—ZODIAC.

The following article, which we do not pretend to understand, is sent by an old San Francisco banker, much given to satire and heretical philosophy. A submission of proofs has not helped the matter. It is believed to relate to a money article in our last issue:

In possession every one knows what money is. Wealth—anything that can command ready or slow money—bank bills, coin, slow notes of hand, bills of exchange, movables or otherwise—a heavy fall of snow or rain upon a dry and thirsty land—once upon a time negroes, goats and monkeys; fish, in the days of the Nazarine, with silver in their mouths to pay taxes with.

Money as wealth no better than steel, iron, lead or copper, sawn timber, potatoes or hard hearted cabbages, since when? Oh fie! Gold and silver just the same as iron, copper—commodities—Oh fie! In the days of Lycurgus gold was effeminate and coin was of iron. Have we any in numismatic collections any where? Go to! The Pioneers have a large collection of golden coins on exhibition at the mint, anterior to and at the time of the Cæsars. Gold stands the wear and tear of ages—The gold of California beat the drums and blew the bugles that led to victory. No gold excitement in California—no Pioneers, and this great state would have grown slowly and piously, and what has been done in half a century would have taken several to arrive at where it now stands. Did not thirty pieces of silver pave the way to the cross and save the world, and if thirty pieces of subsidiary coin did so much, what shall be said of the millions of gold California has injected in the veins of commerce, operating unspent in all the channels of trade, science, and manufactures?

Diamonds, for rarity, splendor, phosphorescent burning in pure oxygen, fragile, a heavy blow breaking their continuity, smashes them to dust. The Kohinoor under a sledge hammer—a lost Pleiade, but the sun of metals, matching in value, under percussion, would serve in leaf to gild the globe.

Tell a man that a ton of iron will make watch springs worth half a million dollars, and that at the headwaters of the Yukon, there is a quality far superior to any known; will he venture thither to pack it to San Francisco for a market? Tell him there is gold in quantity that will enrich him and he will forge his way there, though seven deaths lay between.

Suspend specie payments and let the Risdon Iron Works attempt payment in pig iron; what then? Drive out the *primum mobile*, the Lord's anointed by free coinage of silver; and make room for chaos which will surely come. And for the balance of trade, what was the accumulated debt of one country to another, was it not Alsace and Lorraine? The uses of the zodiac were of the most remote times among the Arabs, the Hindoos, the Chaldeans, the Egyptians, the Chinese. The signs of the zodiac, the zones, the influence of the moon, the balance of trade, out with them! And make delusion fill the chasm—and destroy the illusions, and over the gilded domes the cloud-capped towers of the world will be written, ICH-A-BOD.

CENTRIFUGAL PUMPS.

Every little while some one improves centrifugal pumps, that is, greatly increases their efficiency by some sort of curve, throat, or shape of the casing, but the fact is that all improvements since the very first one made by Denis Papin — the "Hessian suck" — have been within very narrow limits. The last departure is of French origin, having an encased wheel discharging into a narrow slit, concentrating the radial energy in that manner, and preventing its diffusion in a large mass of water, and so on.

The fact is, that all centrifugal pumps work so well that it is common to consider the last one seen as the best, but it is entirely too late to hunt up an increased efficiency by discharging into a narrow slit. The slight gain thus obtained is very well understood, but no one wants a pump made in this manner. The aperture, or discharge, around an encased wheel or runner should have an area equal to the discharge pipe ; so should all other ducts or waterways through the pump, in order to maintain uniform velocity of the water, but practically such a construction will not do, because of structural as well as operating conditions. Neither will a narrow slit around the wheel. It would soon clog in pumping foul water, or when tule straw or roots are to be dealt with.

There are two forces to be considered in pumping against low heads. The "radial force," mentioned in the Decoeur pumps, at first referred to, is a resultant of centrifugal force, but there is also the tangential force imparted by the vanes, which at heads of less than ten feet may be more effective than the centrifugal force, and this would be in a great measure lost by a narrow slit opening into the casing around the wheel or runner.

There are a good many things about centrifugal pumps that must be learned in making and working them, and one of these things is that a theoretical pump is not a practical one, and not very near a practical one. Taking classes of pumps, such as those for high heads, low heads, dredging purposes, and for sewage, their construction has to be modified to such and extent that the art becomes really an empirical one, and we fear must remain so, especially as investigation this far has been limited in extent, and confined to pumps of one class, or for one kind of duty.

THE TECHNICAL SOCIETY.

The regular May Meeting of this Society was held on the sixth of the month in the Academy of Sciences Hall.

Four new names were proposed for membership, and the following gentlemen were elected as full members :

William H. Davenport, Irrigation Engineer..........Visalia, Cal.
Robert Hall, Mechanical Engineer...........San Francisco, Cal.
W. O. Secor, City Engineer...................Albuquerque, N. M.
M. M. O'Shaughnessy, Civil Engineer.........San Francisco, Cal.
Alexander Watson, Mechanical Engineer.....San Francisco, Cal.

The main proceeding of the evening was a lecture on "Silver, its True Place in Circulation," with a review of the circulations of the nations of the world, by Mr. J. W. Treadwell, Editor of the *Banker's Magazine*, San Francisco.

Mr. Treadwell's lecture was an essay containing many startling propositions, the truth of which but few will be prepared to dispute ; and granting the main premises and conclusions derived therefrom, we are certainly at this day groping in the dark in so far as what is called monetary science.

He charges upon the issue of what he calls "credit paper," that is, paper promises to pay, unsecured by coin or tangible assets, nearly all the ills that modern finance is suffering from. Among these the low price of silver, that now is a matter of so much concern here, and still more a matter of concern in India where the rupee has fallen to a little more than half its former value.

The speaker characterized all issues of unsecured paper as swindles of the people, and proceeded by exhaustive statistics, as well as graphic illustrations, to show what a tremendous fact is this credit paper in modern affairs. It is a subject of great complexity. Wise men approach it with dread and distrust, but the politicians, the "political bankers," as Mr. Treadwell calls them, discuss the whole matter, and suggests various kinds of schemes for raising money with the same confidence as they do an act to regulate navigation.

The issue of credit paper among fifteen of the leading nations, the lecturer says, is $3,658,000,000, and of this $1,000,000,000 is in this country. The next largest is Russia with $946,000,000. The largest in respect to population is in Argentina, where $860,000,000 has been issued against a population of 4,000,000, or $215 for each inhabitant.

The speaker denounced the Bank of England as the leader in all this issue of credit paper, showing how the bank was founded on an authorization of the Government, to issue $83,000,000 of such paper in return for that amount taken by the bank from the country, and on which the people pay 3 per cent. per annum.

He cited the Bank of France as a true example of wise policy, having an issue based on silver and payable in gold at a slight premium, and how in the late failure of Baring Bros., of London, the Bank of England had to borrow from the Bank of France to save a panic, or worse. The Bank of Franc, as was pointed out, stood through the Napoleonic dynasty, through the Bourbon and Orleanist régimes, the *coup d etat,* the German War and the Commune, involving the indemnity of $1,000,000,000, and now stands the greatest money concern in the world.

Mr. Treadwell explained the eight kinds of paper issue in this country, and the peculiar or different qualities and condition of each, ending up with the silver certificates for $330,000,000 lying idle in the Treasury, drawing no interest, and in no active use. He suggests, and it seems a plausible proposition, that 100,000,000 of these silver dollars be used in making the Nicaragua Canal, and the silver be substituted by the bonds and shares of the Canal. The coined dollars representing this issue have fallen in value $110,000,000 since they were paid in, and cannot, at that rate, be a security as good as the Canal bonds. The lecture will be published in a bulletin of the Technical Society, and we recommend our readers to examine it with care.

Either the whole system of modern finance is at fault, or else there is something wrong in the premises assumed by Mr. Treadwell. The present free coinage proposal in this country would be a suicidal movement, if the propositions, here put forward, are tenable or even possible, and we are much inclined to the opinion that all tinkering by laws will only have the effect of more rapidly lowering the price of silver.

The idea of making money and values "by law" is a disease of the human mind, an imperfect understanding of the fundamental principles underlying economics. It infests all nations and all classes, and is only to be dissipated by a higher education.

At the next regular meeting, June the 3rd, Mr. Marsden Mansen, C. E., of this City, past President of the Society, will read a paper on "The Circulation of the Atmosphere of Planets."

NOTES AND COMMENTS.

The reception of the American Society of Mechanical Engineers on this Coast, and their entertainment here, was such as to render their visit a remembrance. The circumstances have been so fully set forth in the daily press, that repetition here, even if our crowded space permitted, would not have much interest. There were but two regretable circumstances. One, the hot weather, a thing so unusual on this Coast; the other, the short time allotted for the San Francisco sessions. Perhaps the most fitting thing to be said at this time will be to acknowledge on behalf of the Executive Committee and the city at large, the aid so kindly extended by various friends of the engineering and industrial interests. It would be a pleasure to mention persons and firms that have contributed money, and what is more important, their time, in courtesies and attention to our visitors. May their journey homeward be as happy as the outward one, and their future be a continuance of the success that has thus far attended the Association. The papers presented at the San Francisco meeting have much value, and are characterized in most cases by what may be called exhaustive treatment of the subjects dealt with. We reprint two short papers in this issue, and hope to notice others in the next issue.

Mr. E. H. Booth's article in our present issue, on electrical apparatus and power transmission, will be found the most complete essay on the subject that has appeared. Mr. Booth, who is known to most of our readers on this Coast, brings to his aid a long and thorough experience in the construction and operation of mining machinery and reduction apparatus of all kinds. He takes up the subject in its electrical, economic, constructive and operating phases, as before remarked, in a more thorough manner than anyone has hitherto attempted, and we commend our mining readers to a careful perusal of the article. We hope, in our next issue, to present in a practical form, drawings and descriptive matter of machinery and apparatus from Mr. Booth's designs for the Thomson-Houston Company, with which he is connected.

The local engineering list of this city suffered last month the loss of two prominent members. Mr. Luther Wagoner, civil and mining engineer, who after a professional experience extending over a great part of the continent, settled down here a dozen years ago, has accepted the position of general manager of the Washington Reduction Company and First Thought Mining Company, of Okanogan County, Washington, in which he is a shareholder. Mr. Wagoner was one of the founders, and almost continually an active officer ot the Technical Society of the Pacific Coast; he continues his office and business connection in this City.

Mr. L. L. Robinson, C. E., President of the Miners' Association, and President of the North Bloomfield Mining Co., died on the 5th of May at his home in Contra Costa County after a long illness. Mr. Robinson was a man of exceptional vigor in all of his undertakings, and was identified with many of an important kind on this Coast. He was the engineer of, and constructed the Sacramento Valley Railway, the first one in the State. He was also an early member of the Technical Society of the Pacific Coast.

Mr. G. D. Clark, of Messrs. Clark & Sons, of this City, suggests that eucalyptus trees can be employed to absorb or dissipate the impure and objectionable elements of town sewage. This opinion has warrant in some experiments or, rather, methods, employed in England, where the sewage is collected at an out-fall some distance from towns, and there run by means of cross ditches through "osier beds," or willow gardens. The cuttings are, in one case we know off, harvested twice a year, and pay six pounds, or thirty dollars a year per acre. There is no odor from the sewage, and the growth of the willows is phenomenal. In many other cases the sewage of towns is sold to land owners, and becomes a source of revenue instead of an incubus as it is in many of the interior towns in California. The common method of discharging sewage into fresh-water streams is unhealthy, unjust, and will have to be abandoned here, as it has been in Europe. Mr. Clark's opinion is that the eucalyptus tree is far superior to willow or any other indigenous growth as an antiseptic agent, and coupled with opinions in Australia respecting its "absorbent" nature, the proposition seems a reasonable one and worth a trial.

Mr. P. J. Flynn, author of the work on irrigation noticed in the review colums of our issues of April and May, writes to say that we are in error by saying that he is a "graduate" of Addiscombe College, and that he only passed a competition examination there. We cheerfully make the correction, and with Mr. Flynn himself want to be as exact as possible. At the same time the difference is a technical one, because to graduate, and to pass a successful examination must be much the same in effect if not in nature. This correction should have appeared in our last issue, but was inadvertently left out of the copy sent in.

The North Pacific Coast Railway Company are intending improvements, and among other things a better ferry service, with a new boat to enable more frequent trips. They have invited tenders for a double-screw boat, one screw at each end, and a shaft whole length of the hull. This construction has met with favor at New York, but the circumstances are quite different from here, and we think a more conservative method will be safer, and in the end more satisfactory for the Sausalito route. By constructing a paddle boat with feathering wheels, their diameter can be small enough to place the shaft beneath the deck, and there would be no experiment in the case. The cost of the boat would be less, and her speed for a given power greater, than with the double end screw. Why rigid wheels are employed on paddle boats on this Coast is hard to explain. They hammer a boat to pieces by synchronic vibration, are disagreeable to passengers, who can not read in the vicinity of the paddle boxes, and at best are a crude adaptation. We think that the N. P. C. Railway Company should reconsider the type of ferry boat proposed and adhere to older and better known methods for a run of six miles.

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The President of the Farmers' Alliance Organization has issued a circular warning its members against signing petitions to Congress asking for a grant of money or credit to the Nicaragua Canal Company, and not without reason. Whether the reasons be sufficient is another question. Some argue urgency of the work as sufficient reason for such a step, and if there is urgency enough then the Government should make the canal; but each and every scheme that might make the Canal amenable to the railway power, will warrant the recommendation of the President of the Alliance, above referred to. This is a matter, if ever there were one, that will bear watching, because there is scarcely a chance that any act will pass the United States Senate in a form inimical to railway interests. Either the property or its profits will land in the railway pool, unless there is extreme vigilance exercised on the part of men such as the Alliance is supposed to elect to Congress. Mr. Treadwell's suggestion, mentioned elsewhere, to make the Canal with the "stored silver," seems a good one, and the safest of all that has been presented.

We some years ago read with much interest some views of Richard Tangye Esq., of the great firm of Tangye Bros., Birmingham, England, on the financial policy of the two chief Australian Countries, Victoria, and New South Wales, also have watched the wonderful growth claimed, under the paternal form of government, in Victoria. Some recent advices from there by a correspondent of the *Iron Age*, explains the ephemeral prosperity, or rather the result of it, that grew up under a system that promised every man "two acres and a cow." The colony has, under a system to discourage importations and build up home industries, borrowed in the ten years past the enormous sum of $435,000,000, and this, says the writer, has come mainly in the way of imported goods. The Government recently tried to borrow $20,000,000, more, but could not. There are about 200,000 working people in Melbourne, of which one half are idle. The loss of the Peninsular and Oriental companies shop and headquarters, which were some years ago moved to Sydney because of the enhanced prices and expenses in Melbourne, was one of the first set-backs of the "dear" system in Victoria. The Melbourne exhibition was a "sop to Erebus." The whole has turned out as Mr. Tangye predicted in "One and All," and we are inclined to the opinion that most of the labor troubles and disturbances that have occurred in New South Wales, have been a reflex and reaction of the Victoria methods. The public works, fine streets and care of the workingman are likely to be expensive luxuries, especially if, as is possible, the labor vote should conquer the Parliament as it did once before. Paternal government may do with some races, but not with an English speaking people of our day; who can very well attend to their own business affairs if the government will preserve order and protect property and persons.

There has been a considerable discussion of the matter of a permanent Census Bureau, and there are some reasons in favor of such a method as well as a good many against it. The faults that apply to the present decennial system would act with still greater force in a permanent bureau. They are not inherent or necessary, but an abuse. In the case of the last census the appointment of a partisan politician, one who had as Secretary of the Tariff Commission showed a total disregard or inability to understand the statistics of his own country, was not a proper officer to place in charge of the United States Census Bureau. The census was a political one, and it is trusted, will be the last of its kind. There are many capable men in the country, citizens born here, who are qualified by previous experience for such work, men like Francis A. Walker, whose integrity as well as ability mark them for such duty, and who could have conducted the census work in an accurate and efficient manner, but these were passed over and the work given out to political followers, whose work was so bad that people seem to have but little confidence in it.

The *Examiner*, of this City, in its issue of May 7th, gives some statistics respecting the tax that falls on the industries of this Coast, by reason of the duty on tin plates, which for ten months, from July, 1891, to May 1st, 1892, has been at this port, $451,000. The excess over the old rate is $164,000, and these amounts do not include tin plates made in this country, which would bear the same tax or price as the imported article. To this again must be added, in respect to this Coast, a difference of one dollar a box extra freight on tin plates imported from the Eastern states. Taking the full reported number of people now engaged in this industry it amounts to nineteen firms or companies, all of them in the Eastern states. The principal consumers here were visited by a representative of the paper, and all were agreed as to the serious effect on the food industry of the Coast. The price of the tin should be about $3.25 per box of 100 sheets, instead of that it is $6.00 a box, the duty being about 80 per cent., which is not levied to promote tin mining because there is no duty on tin as a metal, but is mainly in favor of the sheet metal rollers who prepare the stock from iron or steel. Coating the plates is not a very intellectual or important industry, and we think the sooner this tax is done away with the better for all concerned.

The *Tramway and Railway World* has published eight fine plates of the buildings at the Chicago Exposition, that are by far the finest illustrations that have appeared, and in a popular sense afford more information than the many pages of matter devoted to this subject by more pretentious engineering journals. The English technical press has from the beginning kept far in the lead of out own in describing the grounds, buildings, and whatever pertains to this great enterprise. This is, in some degree owing to the price of the journals and their enormous resources, which far exceed what can be claimed in this country. We notice too that illustration by "process" plates, from photographs, is fast taking the place of wood engravings, the same as in the case of magazines and descriptive literature. It has been a long battle between photoplates and wood engravings, but the latter have been beaten and must soon yield the field for the cheaper processes. The views of buildings at Chicago, at first mentioned, is a very successful example of photoplate printing.

The Dutch government have been building a warship 382 feet long, and have completed the "name," which is not defined in a lineal way, but is certainly longer than the ship—as follows: *Koningin Wilhelmina der Nederlanden*, which we translate "Queen Wilhelmina of the Netherlands." The engines and boilers were made by the *Koninklijkefabrickvanstoornenandarewerkteugen*, which again we translate the "Royal works of steam and other things," (or machine products). The Dutch, no doubt, need some war vessels in the conduct and management of their colonies, and to protect their commerce, which is a considerable one, but they are not likely as a nation to throw away their money on "jingo schemes." We must admire above all other things in this stiff necked little nation their devotion to the peaceful arts, and the success with which they keep out of European politics. Thev have learned the value of peace and amity—have become commercial, rich and intelligent, which is much better than having a war establishment to consume the products of her people.

The Commissioner of Patents issued in March last a circular asking those who have models of machinery to send the same to the Patent Office, for display at the Exhibition of 1893 at Chicago. In the circular is mentioned the loss of models by fire at the Patent

Office, but this we think, with few exceptions, was not a loss. These models, most of them, were caricatures. Under the model system the rule was that drawings in a specification must correspond to the model, and as it was impossible, in most cases, to make models like machines, the drawings were spoiled accordingly, and our patent system was a kind of burlesque. Now that models are abolished the patent specifications have become quite different in character, and more perfect. The scheme of having models sent is a good one, in so far as "good models," and there may be a few hundred picked out of the museum at Washington fit to exhibit. There are also in this country many fine models that can be sent, but we fear that most people will not care to furnish them to be shown in conjunction with such as make up the main part in the cases at Washington. The day of models as a means of explaining mechanism is past.

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The Spring Garden division of the Philadelphia Water Works is equipped with orthodox, old-fashioned Cornish pumping engines, and their performance has been such as to warrant adding another engine of large capacity, made at the Southwark Foundry in that city, and having a good many "Cornish" features. The new engine weighs nearly 500 tons, has two high-pressure cylinders, 44 inches diameter, and two low-pressure cylinders, 88 inches diameter. The pump plungers are 37 inches diameter. The floor space occupied is 30×40 feet, and the height of the structure 35 feet. The fly wheel is only 20 feet in diameter, but weighs 45 tons. This engine is to raise 20,000,000 gallons daily against a static head of 250 feet, and with friction resistance equal to 110 pounds per inch pressure, or a duty of 2,500 horse power.

It is singular that we have not thus far had more application of the Davey system of compensating, direct-acting steam pump, by which the benefit of expansion can be gained without rotary parts. The Davey engines are connected to a disc, or crank plate, in such relation to a pump rod, hitched to the same disc, that the movement of the pump piston diminishes as the pressure of steam in the engine falls, after cutting off. The engines are set diagonally with respect to the pumps, and the crank pins of the two in such relation to each other that the "leverage" on the pump rod increases toward the end of the stroke, and to suit some predetermined point of cut-off and expansion. The method is quite simple and effective in the case of water works' engines employed for a constant duty, although the makers of the Davey engines have not, in their contracts, ventured upon guarantees as great by ten per cent. as in the case of the Worthington compensated direct engines made in this country, and provided with a pneumatic compensating attachment to make up for expansion and a fall of pressure in the steam cylinders.

The French engineers seem to have taken up the subject of petroleum engines in a vigorous manner, and judging from what they have done with air engines, and also that the gas engine originated in that country, we may expect a good deal to be added to this new art. There has been recently a treatise written on the subject of petroleum engines, by M. Gustave Richard, C. E., which should be translated as speedily as possible. The industry is an extensive one here, and there is promise of a use wider than in any other section of the country, so that those engaged in making these engines can profitably watch the progress made elsewhere. The work above named is the second one on the subject, by the same author. The first one was published in 1884, and is, of course, out of date now.

At the late meeting of the Institution of Naval Architects, in England, there was a very important discussion of the subject of balancing marine engines, or preventing synchronism between the engines and the vibrations of the hulls. The subject was treated graphically, and in a manner to throw much light on what is a very important feature in naval construction. It is analogous too, or, indeed, the same thing, as vibration set up in machines by reciprocating weights or parts, and we think the paper and discussion before named, by Mr. Yarrow, the celebrated builder of torpedo boats and other special boats, can be studied with much advantage by mechanical engineers. The paper and its discussion does not admit of abridgement, and must be studied as a whole in order to be understood. It is mentioned here to call attention to its republication in several of the technical journals.

We met with recently in an exchange, an attempted explanation of what is meant by "running with the sun," as applied to machinery, and out of a number of illustrations can get no sense whatever, so will go further and say the whole thing is nonsense. Rotation to the right or left, which is what is meant, is relative to the position of a person. Facing the north the motion with the sun is one way; facing the south it is the other way. At the Equator the motion of the sun is in a vertical plane, and no comparison can be made to motion in a horizontal plane. North of the Equator there is a qualification for rotary motion in a horizontal plane, and the figure becomes intelligible, but south of the Equator this is reversed. What is with the sun in one case is against it in the other. We have yet the first person to meet who could define what the phrase meant, except as applied to what is called "right and left," which means the movement of the "top" of a rotating body when we are facing toward the axis of movement. One knows which way a screw turns, by habit, and outside of this, to turn right or left when facing the axis means the direction in which the "top" of the body moves, and this has nothing to do with the motion of the sun.

The method of firing in direct contact with the main shells of common tubular boilers, is just now receiving more attention than at any previous time, and promises a change in the near future. The California Electric Light Company, or the Edison Company, it is now, are erecting boilers in this City with detached furnaces, and some reports from Thurlow, Pa., on a detached furnace plant, are two cases in point. The scheme in general is to provide for the intense combustion in a furnace lined with refractory material, and then baffle the flames, or products of combustion, so they will not impinge at particular points against the iron plates or flues. It seems at first thought that the greatest efficiency of fuel should be gained by convection, and close contact. This is supported by the fact that the heating surfaces of fire boxes or water-lined furnaces are much more effective than flue surfaces, or those removed from the fire, but only "seems" so, and the fact is that by detaching the furnace, no heat is lost, it is only distributed over larger areas, and less injurious to the boilers. The fact is that combustion apparatus has not received so much attention as it should.

Judging by some examples in European practice, we think it is time the makers of "internal combustion engines" turned their attention to compression in a separate chamber, producing an explosion, or impulse, at each revolution. It is true there are some impediments to this; the saving in the general dimensions of an engine, which is theoretically one half, is in a large degree offset by added detail; still there is the important gain of better regulation and a better adaptation for electric lighting which makes up an extensive use of these engines on this Coast. The Campbell Gas Engine Company, in England, are making a well designed engine, having a compressing pump alongside the main cylinder, and, from appearances, the whole engine is nearly as simple as the alternate explosion type. There is, however, one point that seems questionable: the inrushing charge assists to some extent in expelling the burnt gases, which means that there is at some period of the cycle, open connection between the air and the receiver, and an assumed "division of gases in the cylinder" that can hardly be supposed to exist.

In a recent example of crane operating in England, water at a pressure of 750 pounds per inch is applied by means of a pair of hydraulic pressure engines, similar in construction to steam engines, and by due attention to ports, packings, balancing, valves and so on, a very fair efficiency is attained, but not, we imagine, what could be done with California tangential water wheels, that would cost about one fifth as much as the engines. The Pelton Water Wheel Company, some time ago, sent out to England some small water wheels to be employed on the London high-pressure mains, which have a pressure of 700 pounds to an inch, equal to a head of 1,600 feet, which does not exceed some heads successfully applied here. There will, no doubt, be at no distant time, a high pressure hydraulic system in all large cities, and if tangential wheels can be employed instead of reciprocating engines to produce rotative motion in an economical manner, this will do away with almost the only impediment to hydraulic power distribution, where freezing can be guarded against.

Our able contemporary, *Power*, in the issue for April, gives the following table from experiments made with high and slow speed engines, the subject of a paper by Mr. Charles W. Wasson, read before the Cleveland, Ohio, Electric Club. The engines were made by Messrs. C. & G. Cooper, of Mount Vernon, Ohio, and the Armington & Sims Co., of Providence, R. I., both eminent firms, and the results are noteworthy, if they indicate the normal working of the two systems.

Run of Ten Hours.	High Speed.	Slow Speed.
Average electric h. p. developed	563	630
Maximum " " "	813	842
Minimum " " "	486	354
No. gallons oil used	7	8
Water used, cubic feet	3,900	3,800
" " per average electric h. p. per hour	43.29	37.69
" evaporated per lb. coal, per hour, lbs	6.61	6.54
Bitum. slack coal used, lbs	36,900	36,300
Ashes made, lbs	4,890	4,779
Fuel used per average electric h. p. per hour, lbs	6.55	5.76
Combustible " " " " " "	5.68	5
Coal used per car mile, lbs	6.57	6.38
Average amperes	812	907
Maximum "	1,120	1,160
Minimum "	720	720
Average voltage	518	518
Maximum "	535	530
Minimum "	505	510
No. readings at 15 sec. intervals	2,385	2,395
Average temperature water from heaters	186°F.	197°F.
" " " " street mains	39°F.	39°F.
" " of outside atmosphere	43°F.	41°F.
Condition of weather	Rainy	Foggy
Average steam pressure, lbs	96	97
Maximum " " "	102	100
Minimum " " "	90	90
Average chimney draught	$\frac{7}{8}$ in.	$\frac{15}{16}$ in.

The expense of maintenance and attendance, is singularly divided between high and slow speed engines, and for the double-acting type, is much in favor of slow speed engines, but to include the single-acting type with the high speed class, shows the other way. These latter requiring the least attention of all.

The British Patent Office has ventured on what will seem a wide departure from common customs in that country, that of furnishing patent specifications at an uniform price of eight pence, or about 15 cents each. It will be a great convenience, as it is in this Country, to know what copies of specifications cost so they can be sent for at any time, but there are some British patents that will be cheap at the price. There is one on bobinet machinery that costs more than a pound sterling, as remembered about $7.50. The British Office, while it long retained some old and seemingly absurd features, such as the "great seal," a disc of wax six inches diameter and 1¼ inches thick, has, in late years, introduced many useful reforms. The indexing and abridgments are admirable.

Mr. E. H. Booth, mechanical and mining engineer, of this City, now of the Thomson-Houston Co., Boston and Lynn, Mass., in a letter to the Editor of INDUSTRY, speaks of the careful experiments that are continually going on in the works of the Company, and says:

"What seems to me most remarkable in such experiments, is the great care and accuracy with which they are conducted and recorded. By the use of voltmeters, ameters, and other instruments, results are simply read off and noted down. The steam engine indicator is clumsy and inaccurate when compared with these instruments, and I have no hesitation in saying that electrical manufacturers are at this day, in a far better position to guarantee results attending on the use of their apparatus, than has been attained in any other branch of engineering work."

This is a remarkable statement, and is, moreover, true. No other art has ever commanded the same talent and skill. It has been congenial, mysterious, capable of laboratory treatment, and besides, sprung into sudden commercial importance. Learned men in all countries joined in the work and exchanged their discoveries.

Mr. Booth's impressions have much value. He will enjoy the advantage of a training in a different but necessary field. The accurate manipulations at Lynn call for talent and skill, so do the emergencies of engineering and mechanical work performed away from such resources, and without parallel or precedent — a field in which few people of Mr. Booth's years have seen more, and which will be invaluable to him in the business in which he is engaged.

Judge Coxe, of the United States Circuit Court, New York, who seems to have before him the most celebrated patent cases, has recently rendered a decision that will have a good deal of value to the Accumulator Company there, and the Pacific Electrical Storage Company here in San Francisco. The decision was in a suit against the New York and Harlem Railroad Company, and involved the perforated plates, confirming to the Accumulator Company their right in that invention, which is essential in the construction of plates that will endure. It means, in a mechanical sense, "riveting," or clinching the plastic material on each side of the plates by means of perforations enlarged or tapering each way from the center. The Electrical Accumulator Company have expended a great deal in defending their patents, which, it is reasonable to be supposed, have been infringed up to the "danger line," and construed in as barren a sense as possible to favor later inventors. Judge Coxe will become an engineer and mechanic in due time if his Court continues to deal with such cases.

During the visit of the Press Association here, last month, Mr. Burk, of the *Philadelphia Ledger*, in some well-chosen remarks, says:

"There is room for a very large trade here with Oriental countries, as that trade must necessarily come through this port. San Franciscans must remember one thing, however. Situated as you are you must build up the manufactures enough to supply the home demand, and not depend upon the East for manufactured articles. You have the soil, climate, mineral, timber, and all other resources sufficient to become commercially independent of the country east of the Rocky Mountains.

I believe that California will become better known in the East through the delegates to this convention, and just as soon as it is, you will surely have an increase of immigration and prosperity."

No index will be published with the half-yearly volumes of "INDUSTRY," but a full index will be furnished at the end of each year. This, it is believed, will best serve the convenience of binding, and be preferable in every way.

LITERATURE.

North American Review.

MAY, 1892.

This May issue of the *Review* is a "weak one," the weakest that has appeared for a long time, in so far as the political symposium that commonly makes up the first section; and this is not weaker than Benjamin F. Butler's essay on the Behring Sea controversy, which, in style, ideas and phraseology, is of another period and is "pettifoging."

The "Chinese Question," by Mr. John Russel Young, is a terrible arraignment of an unfriendly treatment of the Chinese people, or rather of the Chinese Government, because there is a wide distinction. Mr. Young, in winding up his essay, says:

"China may say with truth and bitterness: 'You claim to be a fair nation! Yet when the heavy hand falls upon us, America aids in striking the blow! You interfere with our suzerain rights over a province, and pilot the Russian into our dominions. You pay your own people four or five per cent. for money, and ask China for ten or twelve per cent. You compel us to pay tael for tael for every loss to the missions from local disturbances—you tell the Chinese that you are not responsible for losses to our people. Your Congress may toss us indemnity as an act of grace, but you compel indemnity from us as a right. You make treaties which we gladly accept! Your people break them, and upon us you devolve the blame. You hold China responsible because Chinese laborers leave Hong Kong, forgetting that Hong Kong is as English as Cardiff or Melbourne. You compel us to surround your missions with troops, and yet in the United States the Chinese are abandoned to the mob. You eliminate from our treaties by act of Congress whatever is of advantage to our people—you carefully reserve whatever helps your own. The rights you deny us in America you enforce for Americans in China. You ask protection and hospitality. You give us fines, imprisonment, and deportation.'"

How far this is true we have no means of judging, but there is one remark following which is worthy of consideration. Mr. Young says:

"The development of our Pacific empire, now in its infancy, rests upon the commercial relations that should exist with Asia. This commercial empire of the East, if I may so call it, belongs to us by the ties of geography, enterprise and sympathy. We have no interests that jar with those of these vast and venerable empires. We do not menace their independence like Russia, nor seek the profits of shame like those reaped from the opium sin by England."

We have, in this Journal, many times argued that no trade of importance can ever grow up between this country and Europe, except in food and crude materials. Nations prosper by trading with those less skilled in the arts of production. On this Coast our market should be China, Japan, the Pacific Islands, Central and South America, especially, however, in Asia.

The exclusion of Chinese people from this country, which Mr. Young does not dissent from, need not call for such a course as that set forth in the quotation. Laws for the purpose can be made, and reasons be given, on courteous grounds, for such enactments.

Minister Romero contributes an article on "Mexican Exports to the United States" that is encouraging. The proportion of exports coming to this country has risen from 56.37 per cent. in 1886 to 71.09 per cent. in 1890, or 25 per cent. of a gain in volume in four years. This is not due, except to a limited extent, to an accretion of the whole volume of Mexican trade, because there has been a falling off in other countries nearly the same. The accretion to American trade would have shown a much larger amount if it had not been for the regulations which cut off the importations of lead ores.

Consular Reports.—Nos. 135-36-37.

In Report No. 135, for December, 1891, U. S. Consular Agent William P. Smyth, of Huddersfield, England, writes of the tramways and water works of England, and shows the effects of private and public ownership in such works. The following remarks from Mr. Smyth's paper are worthy of careful consideration:

"Cheap gas and cheap water, as well as cheap transportation, are three essentials that enter largely into the comforts and conveniences of life in large cities. The two latter especially play an important part in the sanitary affairs of communities, for while one exerts its beneficial effects in a more direct line, the other contributes to results almost similar by assisting the mobility of population and relieving conjested districts where low social conditions prevail and moral and physical diseases are generated. To the masses in the cities, therefore, the tramway, as well as the water supply, becomes a great institution, localized and popularized by this system of municipalization. Its regulation or control by municipal authorities has a special humane feature which deserves to be recognized, a feature that might well be considered by the owners of street-car lines in the United States, that which relates to the interests of employés. I have noticed particularly that employés of tramways, in those English cities which operate their own lines, are better taken care of than most of their kind in the United States. This is entirely due to that broad and humane policy which some public bodies are capable of exerting toward their servants, the very opposite of the selfish and inhuman treatment which is their sad allotment in the affairs of the average joint-stock company. There is more attention paid to their personal comforts, in the way of clothing, housing and the duration of their daily service."

Consular Agent Smyth, in another section on "Tomato Culture in England," says there are, in that country, over one million of square feet of glass employed in hot house culture of tomatoes alone. This amounts to twenty two acres of glass surface and relates only to the early growth, the principal supply coming from the Channel Islands. This will be news to most people, who supposed that tomatoes are scarcely known in England, and it is true that only a few years ago they were seldom seen there.

Consul General Wallace, at Melbourne, Victoria, warns young men in the United States from going to Australia to seek employment, a matter not to be wondered at. There is no need of young men going from this country to Australia for employment, and especially to Victoria, when there has been, for many years, a lack of employment even for those who belong there. The Government of Victoria, more than any other that can be named, has adopted a "paternal" policy, and has already reaped some of the fruits of that system, in pretty constant deputations and demands of the work people for employment. We think the young men in this country can do better at home, if they want to "work."

In Report No. 137, Consul G. W. Roosevelt, writing from Brussels, Belgium, on plate glass manufacture in that country, gives the following description of some of the principal processes:

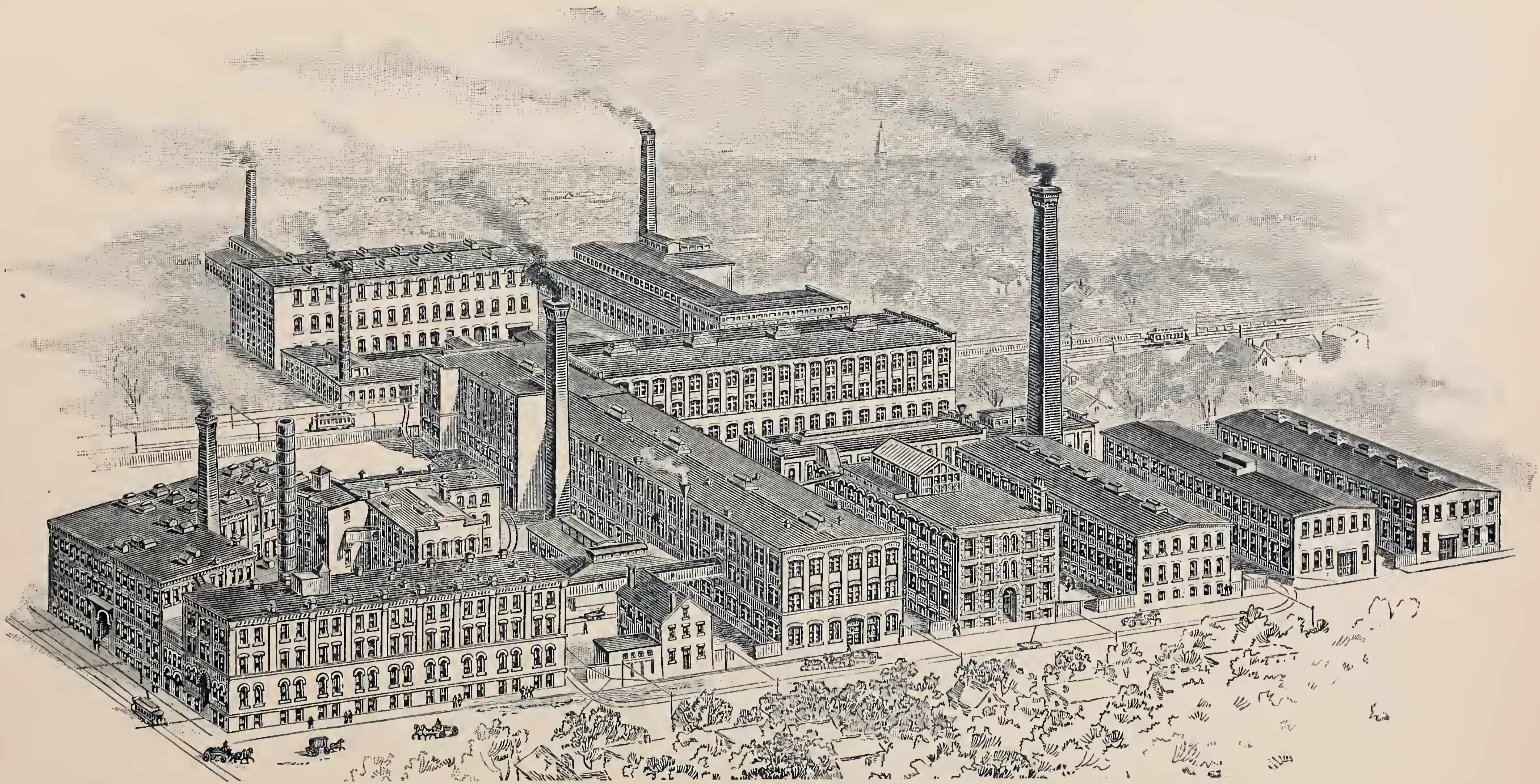
"The glass, when taken from the furnace, is spread upon a cast-iron table, the mass is then rolled into sheets of from 9 to 10 and from 14 to 16 millimeters in thickness. The former is designated as thin, and the latter as thick, plate glass. This operation constitutes what is known as rolling, and the glass thus produced is called rough glass. After the glass has been completely cooled it is placed upon cast-iron tables, upon which a bed of plaster of Paris has been prepared to receive and firmly hold the glass in place. Particular care is exercised in filling in the spaces between the glass and the table with plaster, so as to securely seal the glass to the table. It then passes through a series of grinding and smoothing until the thickness is reduced to about one-fourth, and the face of the glass has been thoroughly polished. It is removed from the table, turned, replaced, and polished in the same manner as above described.

The operation of smoothing and polishing costs 6.50 francs ($1.25) per square meter. The cost of the rough glass is 7.50 francs ($1.45) per square meter. The total cost of glass when finished to a marketable condition is 14 francs ($2.70) per square meter (10¾ English feet)."

Imports of Belgian plate glass into this country are about $2,000,000 worth a year.

U. S. Consul General F. H. Mason, of Frankfort, writing respecting this manufacture in Germany, gives a very full description of the processes there, and hints at various trade secrets, which we believe to be nearly non-existing, in any degree worth considering. The mysterious part of these trade secrets is usually of no consequence.

It is a great pity that grinding and polishing should be required in this manufacture, and that no means of casting the plates true and smooth enough to have the main qualities of ground glass or plate glass, as it is commonly called. Such glass is very desirable in buildings, and the successful production of ground and polished plates at Kokoma, Indiana, is an important manufacture in this country, one that deserves encouragement a good deal more than tin plate making, because the material is a natural product, and the skill required of a higher class.



Works of the Thomson-Houston Co., at Lynn, Mass.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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The phenomonal development of electrical science, in late years, has thrown a corresponding strain upon the resources of skilled production, and, while attention has been mainly called to scientific discovery, the ingenuity and skill demanded by the agencies of application may well dispute a first place in this development.

The two branches have gone on together as parts of a whole, with intimate interdependence; one supplementing the other, and a result has been the creation of a new branch of technical engineering of wide scope, comprehending physical, dynamical and constructive branches, all of an intricate nature.

To deal with a science and an industry of vast proportions in this rapid manner has called for a centralization of knowledge and skill. Segregated effort was too weak to cope with it, and we see, in nearly all countries, the rise of vast works partaking of the nature of laboratories, factories and engineering works combined. The Thomson-Houston Company, in this country, and the Siemen's Works, in Berlin, Germany, and London, England, are examples of this centralization, and we believe, in no case, has it been charged that the vast commercial power thus created has been employed in other ways than to promote and cheapen the use of electrical apparatus and widen its application.

Dr. Thomas Addison, Manager of the Pacific Division of the Thomson-Houston Co., who has recently visited the central offices in Boston and the great works at Lynn, Mass., says the energies of that Company, and of its staff of skilled men, are directed mainly to improving the efficiency and endurance of apparatus, and, at the same time, by organized manufacture reducing its cost to consumers.

Between the founding of this business in 1881 to its present state in 1893, a period of only twelve years, has been crowded a history of changes and events that could well fill the space of half a century. This history, while one of much interest or even romance, if that term can apply, must be passed over, and this notice be confined to the beginning and end, or the present rather, because the end is not yet.

From the struggling American Electric Light Company, at New Britain, Conn., to the immense plant shown in the frontispiece ; to the vast scientific and industrial business of which this plant is only an exponent, in twelve years, indicates an indomitable spirit and confidence characteristic of the American people in such enterprises.

It is possible, or even probable, that Professor Thomson foresaw or conjectured, from the beginning, something of the part electrical phenomena was to play in the human economy. His habits, training and natural disposition are such as to lead to inductive conclusions. He began his electrical experiments in 1876 when Professor of Mechanics and Chemistry in the high school at Philadelphia, which has a rank quite different and much higher than what is commonly called a high school. Professor Houston, of the same institution, was associated with him in these experiments which, from the very first, were directed to practical utility.

In 1878 a dynamo was set at work to light an establishment by means of eight arc lamps. It was a commercial success, and from that followed the present business in which, during the year ending December last, over five thousand dynamos and motors were turned out by the company. The aggregated weight of apparatus made was 34,000,000 of pounds, or 17,000 tons.

The works, as shown in the plate, have a floor area of 32,000 square feet, or over 7½ acres. The number of people employed in the works is 3,500. The original capital stock was $50,000. Now it is $15,000,000. The Company has absorbed fifteen other companies and firms in various parts of the United States. The shareholders are prominent men in all parts of the country ; so that it is, in a sense, a National industry of which we may well be proud in this country.

Coming now to the particular circumstance that has called out this notice. The Thomson-Houston Company have taken, and are now fitting up, the entire building on First Street, in this City, where their offices have been situated for some years past. The Pacific department, under the management of Dr. Thomas Addison, is to be amplified by the addition of executive, electrical, engineering, mining and commercial departments that will be provided with offices on the first and second floors. The upper floors will contain a draughting room, fitting and repair shops. A store of general supplies, and the counting room, will be on the first floor.

If space permitted some account would be given of the technical nature of the Thomson-Houston Company's productions and works erected on this Coast, but these are set forth in the Company's trade publications, and are, to a great extent, known to our readers.

PROFIT SHARING.

No. II.

In the April issue of INDUSTRY there was an article on the subject of "Profit Sharing," which has called out a number of letters, in some of which there is a request to further elucidate the views presented in the article named. This can be done, but compendious treatment of a subject so prominently before the public mind, is commonly of more value than long argument. Suggestive, instead of exhaustive treatment, is more apt to command attention. There are few who do not prefer to make up their own opinions from personal inferences or observations, after a suggestion is given as to a line or mode of inquiry, still something more may be said.

The article first written was based mainly on observations and facts arising from actual contact with skilled labor, in this and also some other countries, and for that reason may have peculiar interest.

Attention was drawn to this subject in a special manner some years ago, when in England, by a circumstance in London, illustrating the effect of patronizing skilled workmen, one that will fit similar cases in this country, where the spirit among mechanics is much the same as in England.

A young and vigorous engineering firm in London, that were making rapid progress, and felt that their success was in a great measure due to the skill and coöperation of their workmen, concluded to show an appreciation of that fact, by giving their employed force, of about 125 men, a dinner at Hampton Court, a noted old place fourteen miles from Central London.

The dinner was given in good style. There were a number of invited guests. Speeches were made, toasts drank, and the rest, in most amicable form, and the next week these same men struck for higher wages!

The owner was anathematizing this spirit among his men, just after he had been so kind to them, and in counselling with him at the time, it required no great effort for us to connect the dinner with the strike.

The men had done their work as agreed, for stipulated wages, in a country where bargains are sacred. The display of profits and a patronizing spirit in the dinner matter, had produced just the opposite effect from that expected and intended.

The analogy in this case to any one where profits are divided, is very clear, if the profits are to be declared by the owner, on his own basis of computing them. They are merely an increase of wages as a "gift," and an acknowledgment that his side of the bargain is better than he thought for. In other words, a patronizing present that places his men in a menial position, as recipients of a favor; commonly, too, a favor that the men understand is to be repaid by extra zeal in future.

In any case where an employer audits his own accounts, this is a very fair construction. If, as is common in joint stock companies in England, where the accounts are turned over to a firm of public or sworn accountants, to be made up by them, the case is different, but we have never known of this being done in this country, in either firms or companies.

It is useless, however, to consider profit sharing, or any method that puts workmen in a position of dependency, unless labor be classified. What is applicable to unskilled routine labor may have no application or relevancy to what we call skilled work. The two things are essentially different, and require different treatment. Where works are conducted in the manner common in Continental Europe, like large families, the proprietor often lives in the works, knows and cares for all his work people, a kind of industrial feudalism, it may be called, profit sharing may and does succeed very well in some cases already tried. In the North of France, for example, also in Belgium, adjoining, can be seen this family system, where gifts to workmen are a concession and kindness, so intended and so construed. People are apt to confound this with the system at Saltaire, in England, or at Pullman, in this country, but there is a wide distinction between the two cases. The habits, ideas and environment of the people are different. Here, employment takes the form of a contract, as it should do. There, it is in a degree communistic.

As remarked in the previous article, it is inconsistent and illogical to connect a workman's time and wages with the capital and conduct of a business, where he is to exercise no control, and even have no knowledge of these things. It is, in the case of loss, "taxation without representation." A mechanic is responsible for his work, including in that term a due observance of his employer's interests, and there his responsibility ends. Whenever he is put in this position his work is good, and his dignity comes into play. If the work is well and intelligently performed, the responsibility of failure in a business is shifted to his employer, who controls capital and conduct; emulation is set up, and we have the normal working of skilled industry.

Such a system would soon assert itself by natural selection, if there was sufficient knowledge of the labor cost of commodities, so as to enable rates to be set, but this we have not, and are not likely to have, because of a dilligent effort to cover up and conceal labor cost, so that workmen may remain under the impression that their wages are high in proportion to the amount of work performed. On this Coast it is true the labor cost of production is higher than in other countries, the Australian colonies excepted, but it is not true of the Eastern States, and the circumstance operates in a serious manner against our local industries here in California.

In the machinery districts in England, where machine work is done "to estimates" or by contract, the cost of all standard or regular operations is well known, so there is no difficulty in setting off the shop work, on an estimate to those who perform it; they want nothing to do with profits or their employers' affairs, further than the labor.

In other than skilled industries, or for work not requiring trained mechanical skill, the problem is altogether different. There are industries, but not a great many, where the labor cannot be set off and estimated as a distinct element in production. There are also, in all industries, certain kinds of service that must be paid for by time, at a stated salary, or per diem. In such cases there may be no better way at present than to make some portion of the pay or salary contingent upon an employer's profits, but it is none the less illogical, and open to nearly all the objections before pointed out. The coöperative plan is much better, is, indeed, a natural and rational system of apportioning the gains of industry when risks can be made equal. The impediments to the system are that, except in this country and in England, workmen do not accumulate savings for such a purpose, and there is a lack of legislation to regulate and control coöperative ventures.

In England a great many cotton mills have been built on the coöperative plan, and other interests are successfully conducted on the same system, but this far it has made no headway in this country, where business is more speculative, and prices fluctuate so as to call for management beyond the powers of a workingman's directory. There is also, as before intimated, a lack of information respecting the labor cost of commodities, so the regulation of a coöperative investment is very difficult.

The United States Government has devoted as much to research, respecting certain phases of labor, as any other country, perhaps more, while most of the States, by means of labor bureaus, have collected a vast amount of useful statistics, but singularly enough, all have avoided the first and most important part of all, which is the comparative amount of labor cost in commodities.

Nearly the whole mass of data collected by the General Government has been directed to ascertaining the "rate of wages" and cost of living in various countries, which is the tail of the subject, so to speak, and not its head. There was, it is true, under the previous administration, a commission appointed to investigate the labor cost of commodities, which performed some useful work, but its career was cut short when it was discovered that such investigation had a practical bearing in the way of controverting certain assumptions respecting the amount of wages entering into home manufactures in this country.

It does not matter, however, what the effect may be, we cannot hope for any permanent improvement of what is called "labor trouble," until the comparative amount of labor cost becomes the principal feature in the consideration of relations existing between employer and employed.

So long as men will, in their ignorance, demand more wages than their work is worth, or produces by the world's standard, there can be no hope of avoiding strikes, nor will there be any reasonable argument to present against strikes until this labor cost of commodities is disclosed, and there is an understandable and just argument with which to meet unreasonable demands.

Suppose, for example, that the workmen in any regular manufacture strike for higher wages, when such wages cannot reasonably or fairly be paid; what are the arguments that employers can present to convince workmen of the unreasonableness of their demands? This is reducing the matter to a practical form, and we ask especial attention to this query. At present such answer must be, "the rights of capital;" the want of profits as shown, or claimed, on the employer's accounts; the bettered circumstances of workmen now as compared with some other time or in some other country. Such things have no effect. Workmen are not influenced by such arguments, which seem irrelevant and insufficient, and are so. If, on the contrary, an employer could answer the demand for higher wages by pointing out that wages are a fixed or determinable amount in the cost of producing, and not a matter of his choice or control, and if to this argument he could show that he was already paying for labor cost as much as other firms, places, or countries, that would be unanswerable in respect to all industry devoted to commodities entering into the neutral markets of the world.

There is a continual assertion that the labor problem is not understood, which is true. There is scarcely a legislator or an employer that can discuss it rationally, because the principal element is omitted, and the subject as presented consists of "symptoms" and assumptions. Until the cost of production is divided into its factors of material, expense, labor, and profit, and these be considered independently, as well as collectively, there can be no solution of what is called the "labor problem."

The latest phase, that of organizing different skilled callings and trades, is no solution, nor near one, except that by multiplicity of counsel the unions may arrive at some system of ascertaining labor cost, and regulating their demands on economic grounds, instead of proceeding blindly to exact what is impossible or cannot exist. To raise wages is not within the power of employers, except by reducing other components. The remedy must be applied further back. If wages must rise, other components must fall. The aggregate must remain where it is, or where the world, as a whole, fixes it. No one country, and much less a firm, can alter the market price of any staple commodity, except for local consumption, and consequently cannot increase the wages component, even if they would.

Profit sharing cannot help or even affect the matter, except as it may increase the efficiency of workmen, and even if it have such effect, its other objections far override such a gain. It is going backward; a reversion to old theories and doctrines respecting labor, and ignores the only power that gives promise of settling labor disaffection, namely: setting off labor as an independent element in production, and making it responsible, elevating the workman to a joint risk and position that will recognize his power, manhood, and independence, in so far as his part in our productive industries — the labor element.

In the previous article we showed how this can be, and is, done in certain industries. It is no visionary scheme, but simple common sense, and the application of methods for which rules and data, if not complete, are nearly so.

In this country there are formidable impediments, as all must admit. There is, first, a fluctuation in prices, caused by a home market, and the adjustment of production to consumption. There is continual fluctuation, "hard times," and "good times," as we say, following spasmodic consumption and the waverings of faith in investments. Second, there is the matter of irregular profits, and the effect this has on the amount of first cost that can be set off to labor. This evil grows out of and is a corollary of the first one named. Profits are not set off positively, and adhered to, as they are in Europe, because the continually shifting prices of material and other things, as well as competition, prevents regular estimates of profits that are adhered to.

One firm cannot put a regular scale of profits in their estimates when a competing one does not, but even these impediments need not hinder the labor part from being treated independently. Wages must be paid as agreed upon. The "goods" are delivered according to contract, and, come what will, the labor account must be paid. It is the other components, especially material, that disturbs the prime cost of manufactured commodities. When material rises in price, or there is no market for a commodity, there is usually an attempt to curtail wages, because this is the most flexible among the cost components. This is bad enough, but when it comes to making wages directly contingent upon such fluctuations, as is proposed in profit sharing, the scheme presents no practical solution of the problem of wages and labor, as it now exists in this and other countries.

SAN FRANCISCO CONVENTION OF A. S. M. E.

There were presented at the meeting, above named, twenty papers on diversified subjects, some of them involving a great deal of labor. One of the most lengthy and novel, was that of U. S. Naval Constructor, A. W. Stahl, whose writings on technical subjects are well known. The subject was the "Utilization of the Power of Ocean Waves," and the essay, so far as we know, with one exception, the first careful analysis of wave power. The exception is a less extensive paper by the same author, presented, last year, before the Technical Society of this City, on the "Trochoidal Theory of Waves."

The present paper contains some general remarks upon the nature of waves, and then proceeds to a development of the theory of their trochoidal form and movement and the resulting forces; involving diagrams, formulæ and tables, among the latter, one of energy, or horse power, per unit of breadth, applicable to regular deep sea waves, and approximately, for waves in shallow water.

The theories and computations laid down will perhaps constitute a final literature on the subject, but it is astonishing how far popular conception is in error respecting the form and nature of waves, which are commonly supposed to be mere undulations, or rythmic vibration, set up as the motions of a pendulum are, and a simple rising and sinking of the water. Trochoidal, meaning a rolling motion on a plane, as in the case of a wagon wheel. Applied to waves shows a movement and force delineated by what the author calls distorted verticals, and exerting horizontally an energy that can be best utilized by vanes pivoted at a distance below the surface, or at the bottom in the case of shallow water, and just the reverse of most attempts to apply such power by means of suspended, swinging vanes.

The author reviews various methods that have been proposed and attempted for utilizing wave power, most of them conforming, in a very limited way, to the requirements as set out in the graphic and mathematical portions of his paper, and remarks:

"In accordance with the principles just set forth, it has been proposed, jointly by the author and the late Mr. Richard Gatewood, U. S. Navy, to utilize the movements of the distorted verticals by opposing thereto movable vanes pivoted or supported either at their ends or other points of their lengths, so as to move in general accordance with the motion of the distorted verticals, and thus to receive and transmit the maximum effect of the wave movement."

Then follows diagrams and explanations of apparatus adapted as nearly as possible to the utilization of the energy of waves, presenting, in some cases, difficulties of construction and maintenance, but undoubtedly correct in principle, or the mode of operating. Respecting storms, Constructor Stahl says :

"To prevent damage to the apparatus in a heavy storm, some of the motors are located in enclosures, the gates of which may be closed in bad weather, and others are arranged to hoist out of the water altogether. But as the energy of the waves is very much greater during a storm than with an ordinary swell, it hardly seems wise to throw the motors out of action at a time when they could develop the most power. We propose, therefore, to make our vanes of such length that they will reach to the top of the largest waves that can be faced with the strength of the vanes as constructed. When the size of the waves increases beyond this limit, and huge breakers come rolling in, the crests of the latter will be considerably above the upper ends of the vanes so that the vanes will not be injured by the breaking of these crests ; and as the motion of the water rapidly decreases below the surface, we consider that our proposed vanes may safely work in any weather, being entirely below the reach of the breaking crests of the waves in a heavy storm, while they project up through the wave crest in ordinary weather."

On the whole it may be said that efforts to utilize the vast force represented in wave action have not been encouraging, and failure has, no doubt, been to some extent, perhaps large extent, in a misunderstanding of the nature of waves, and the best mode of presenting surfaces to be acted upon by them. There is, however, but little hope, even on this Coast where conditions favor wave motors, of accomplishing much by cheap apparatus. Structures for the purpose will have to be extensive, and erected on a scale far surpassing what is required for a single purpose, or for a small amount of power.

The paper by Messrs. Green and Rockwood on "Two Cylinders *versus* Multicylinder Engines," includes a test made with a triple engine operating three cylinders of 12, 16 and $24\frac{13}{32}$ inches diameter, in series, and also with the intermediate-cylinder cut-out.

Mr. Rockwood had, in the *Railroad and Engineering Journal*, of December, 1891, contended that no more than two cylinders were required to attain the highest theoretical economy of steam, and the tests, forming the subject of the present paper, were made to ascertain, or bear out, the truth of that assumption.

The following table, which is adduced from the experiments, gives two tests of the compound, and two of the triple arrangement. It is remarkable in respect to economy in both cases, showing, as the authors claim, the smallest water consumption of any trial of the kind hitherto made in this country.

GENERAL RESULTS OF FOUR TESTS OF A TRIPLE-COMPOUND ENGINE, RUN BOTH AS A TRIPLE AND AS A DOUBLE COMPOUND.

Test.	Engine.	Duration Hours.	R. P. M.	Average Steam-Pipe Pressure.	Average Indicated Horse-Power.	Water per I. H. P. per hour	Dry Steam per I. H. P. per Hour.	Weight of Water used in Jackets per Hour.
						Lbs.	Lbs.	Lbs.
A	$\frac{12 \times 36}{24\frac{13}{32} \times 48}$	5 (7–12)	79.2	142.	187.11	13.41	13.06	330.3
B	$\frac{12 \times 36}{24\frac{13}{32} \times 48}$	5 (1–6)	79.3	142.	180.71	13.11	12.76	330.3
C	$\frac{\frac{12}{16} \times 36}{24\frac{13}{32} \times 48}$	5 (7–12)	79.0	142.	199.08	13.01	12.67	416.0
D	$\frac{\frac{12}{16} \times 36}{24\frac{13}{32} \times 48}$	5 (1–6)	79.0	143.	178.16	13.25	12.90	388.8

The average water consumption in the four tests, lasting over 21 hours, is 13.195 lbs per horse power per hour, and is nearly equal to the celebrated Sulzer engine trials.

"An Experimental Locomotive," by Prof. W. F. M. Goss, of the Purdue University, Lafayette, Indiana, is a very interesting paper in so far as presenting a novel means of testing locomotive performance in a laboratory way. The engine, which weighed 80,000 pounds and typical in every way of common practice, was mounted on free wheels, or rollers, set in a pit and representing the rails on which the engine is supposed to run. On the axis of the idle, or traction, wheels are placed friction brakes, connected with dynamometers to measure the tractive force of the engine.

The paper consists in a detailed description of the various apparatus employed, but does not include any tests, or results, attained.

A practical suggestion offered by this paper, and one of value, is, that standard machines can be purchased and employed for experimental purposes with no other loss than wear and tear, and the interest on the investment for the time employed. In this case a standard locomotive was bought at Schenectedy, N. Y., at a price, no doubt, as low as the same engine would have been supplied to a railway for, and it can be turned over at the end of the trials to some line using locomotives of the same make or type. This is not the same thing as a firm or company lending machines for experimental purposes, because that imposes obligations and often restrictions, not desirable.

The paper on "Machine Moulding," by Mr. Harris Tabor, sets forth very fully the advantages that may be gained by the employment of machinery in moulding. The duplication of work in modern manufactures, now wonderfully extended in this country, should certainly admit of the application of machinery for this purpose, and the methods set forth in the paper have the merit of simplicity, and also analogy to successful practice in this country and in England, especially the latter country, where, for more than twenty years past, large quantities of castings have been made by machines with a saving of metal equal to ten per cent., because of the greater uniformity of sections, also something in extra price, obtained for castings because of greater exactness.

We allude especially to the practice of Messrs. Ransomes of Ipswich, England, although the same methods have doubtless been applied by other firms there, especially in making railway castings. Messrs. William Sellers & Co, of Philadelphia, Pa., and the Lane & Bodley Company, of Cincinnati, Ohio, employ machines for moulding pulleys. The firm first named, began this method soon after the Ransomes in England, and, so far as known, have not deviated from it, or found any difficulty.

In addition to the functions of the machines referred to, Mr. Tabor proposes that the operation of ramming be performed by a steam piston, and presents certain facts to show the effect produced; with a diagram to illustrate the penetration of pressure, or, in other words, the friction of sand in a mould and when confined. The whole scheme seems practicable, and free from the refinements and complication that has characterized various other inventions for the purpose that have been heretofore proposed.

"Governing Steam Engines" by Mr. William S. Aldrich, of Baltimore, suggests a dual control of the speed of steam engines by means of a centrifugal governor, regulating the range of a valve, or point of cut-off, and in addition for electric purposes, load governing by means of electro-magnetic force applied to revolving or oscillating piston valves having helical ports. Load governing means, in this connection, control of an engine's valves by the variations of resistance, or load, instead of by speed, as in the case of a common centrifugal governor. Mr. Aldrich's proposition is to combine the two, or supplement one by the other, each acting independently, the load control to be derived from the electric generators driven by the engine.

It is very certain that the ordinary means of controlling the speed of steam engines for electric purposes leaves a good deal to be desired, and as this proposition of Mr. Aldrich does not involve either expensive or complicated mechanism it is to be hoped he will reduce it to practice, and report the results.

Load governing, by the way, so far as we know, is a San Francisco invention. There is, somewhere in this City, a model of a "load governor," invented and patented before the Ball Company, at Erie, applied it on their engines. The model is operative and quite ingenious, setting forth very clearly the principal of governing by "resistance."

Mr. G. C. Henning, New York, contributed an extensive paper on "The Elastic Curve and Treatment of Structual Steel," accompanied by twenty-five pages of tables made up from tests made on plates and bars of various kinds; also plotted diagrams showing the same work graphically. This paper occupies forty-five pages of the transactions, and is, no doubt, a valuable contribution to a subject much requiring investigation at this day. The extent and nature of the subject is such as to preclude any review of it here. except to remark that the effect, and especially the methods of annealing, will be a surprise to metallurgists.

Mr. B. J. Dashiell, Jr., of Pittsburgh, Pa., a junior member of the society, contributed a paper on "The Electric Railway as Applied to Steam Roads," a somewhat confusing title, both in its relevancy and the etymology of the terms employed in the title. "Steam roads', is rather confusing. The paper relates mainly to the "Weems Railway," of which our readers will remember various drawing and essays that appeared some months ago, and also to an electric locomotive employed in Massachusetts for freight hauling on a standard gauge railway, and a postal electric train at St. Louis, both running on standard ways.

The main feature of the paper, however, is a set of tables computed to show train resistance at high speeds, or at different speeds, and with different areas exposed. The areas exposed per ton are, in the computations, from 5 to 0.1 square feet, and the limit of speed 120 miles an hour. As an example, an area of 5 square feet at a velocity of 100 miles an hour has an air resistance of 75 pounds, a tonnage resistance of 17.6 pounds, and a total resistance of 24.6 horse power per ton, that is, a ton of weight with an exposed area of five square feet.

The tables cover speeds from 1 to 120 miles an hour, and, as before remarked, exposed areas from 5 to 0.1 feet, and if correct will prove very useful in various computations respecting train resistance.

There are a number of other papers of much interest, which the space at command will not permit us to notice.

TREATMENT OF GYPSUM.

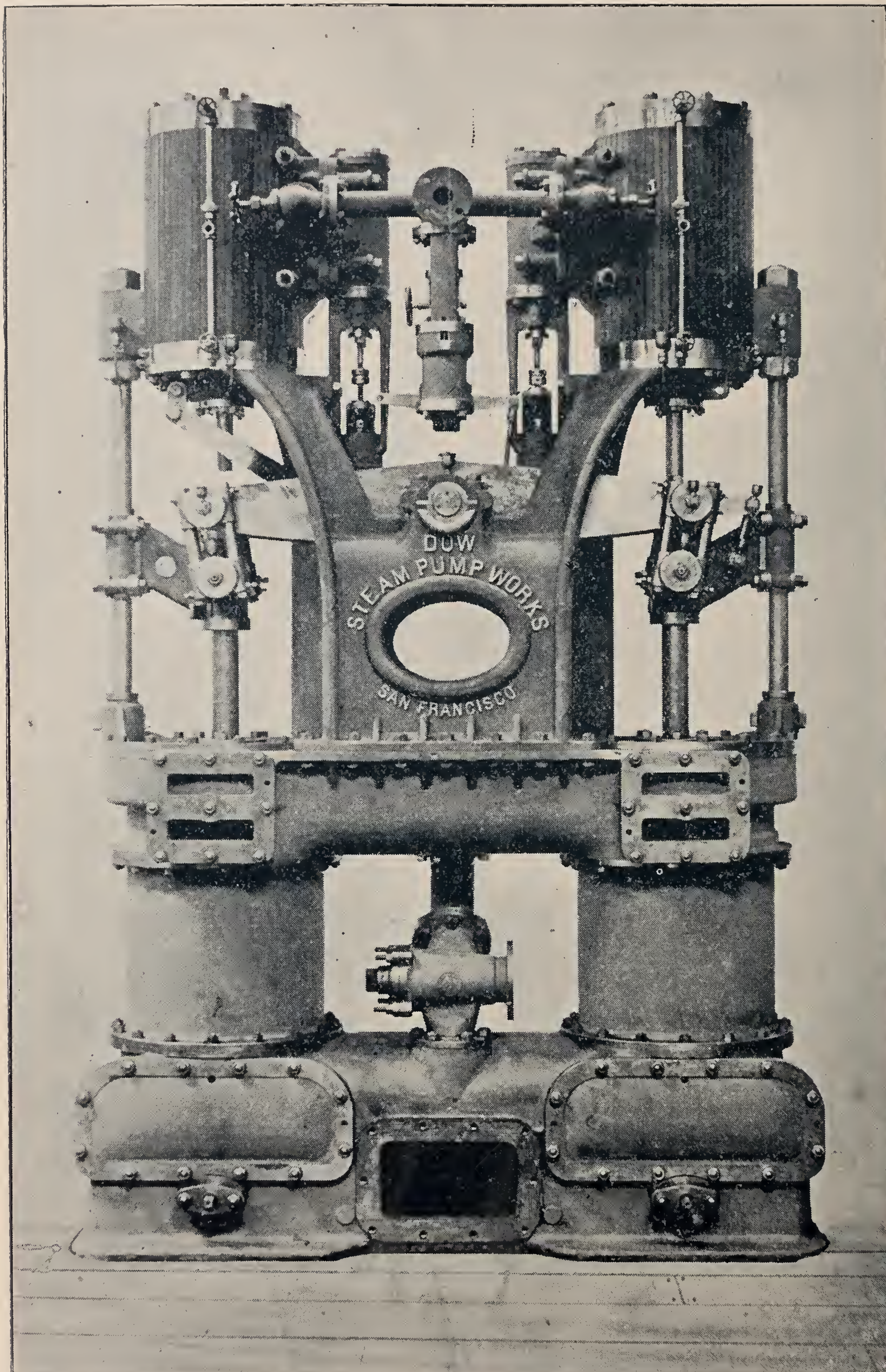
Mr. von Geldern, Secretary of the Technical Society, sends the following :

A new technical use of the marshmallow root (*althæa officinalis*, *L.*) has been noted, and has lately been discussed, which is likely to create quite an industrial demand for it.

It has been discovered that this root, if added as a fine powder to plaster of Paris, or gypsum, say up to three per cent., will effectually retard the setting of the plaster for some time, enabling the moulder or artist to work without hurry, and consequently with greater care, assuring him a more careful completion of his work, enabling him even to repair it by plastic additions.

The latest experiments have shown that a mixture with eight per cent. of the root powder will retard the setting of the moistened plaster still longer, so that the incorporated mass may be rolled into plates, around a cylinder, and may be shaped into all sorts of forms. It will become hard as a stone, and by the addition of a coloring matter, it may be made to assume any hue or desired imitation.

These features of the marshmallow are worthy of our careful consideration, and there is no doubt that these valuable properties will be fully taken advantage of. An experimental field is here opened that may promise useful results.



Dow Steam Pump—U. S. Armored Vessel "Monterey."

AIR PUMPS AND AUXILIARY ENGINES.

U. S. ARMORED VESSEL MONTEREY, DOW STEAM PUMP WORKS, SAN FRANCISCO.

The *Monterey* is now nearing completion, and has for some months past been gradually disappearing in the water, as her armor and machinery have been mounted. She is of the type called "Coast Defense" and is a peculiar looking vessel, in fact a "floating fortress," but with a speed set at 16 knots an hour.

The low free-board, consequently low decks, crowds the machinery into the smallest space possible, and as most auxiliary parts are dual, the vessel becomes one of the most wonderful examples of "condensation" that has ever been seen.

No one would believe, when looking at the vessel, the enormous amount of work that is crowded beneath her main deck. If it were set up in a building in the ordinary way it would fill one of our large factories, and yet everything must be reached, must operate well, and as before said, much of it is double, as in the case of the air pumps shown in the plate opposite.

These pumps were constructed at the Dow Steam Pump Works in this City, the engines operating by what is known as the Dow valve movement. They are so arranged that the engines are in duplicate, one engine being designed to run both air cylinders, and the other being held in reserve, as shown in the plate opposite, it requiring but a few moments to change from one engine to the other.

The air pump cylinders are also so arranged that one can be used independent of the other, or both together, as the occasion may require. The great advantage of the direct-acting type of air pump over that driven by a rotating engine, is the greater range of speed that can be obtained with this class of engines, which is impossible in the case where the air pump is driven by a rotating one. This is a very desirable feature in naval vessels, which as a general thing are worked at about one half power.

The most novel thing about this very creditable design is a controlling apparatus—a go vernor for regulating the speed at which the pumps operate. It is difficult to explain by words alone, and as we hope soon to publish detail drawings of the apparatus, we will for present purposes say that it consists in the employment of two small separate pumps, operated from the main one. A certain predetermined portion of the discharge from these pumps has to pass a piston, and the ducts are so adjusted that when the main pumps are operating at their normal speed the piston is undisturbed, but if the speed is increased, the piston is moved, acting directly on the steam valve to which it is connected, as shown between the steam cylinders in the plate, so the engine at each stroke is supplied with a quantity of steam required by its speed and duty.

This system of regulation has been applied by Mr. Dow to various kinds of pumps, and is in some respect analogous to what is called the cataract, employed with Cornish pumping engines, but operating in a different manner. The class, or type of apparatus in which it belongs, is one of much interest, not commonly understood.

Among some of the other Dow Steam Pumps on the *Monterey*, are the feed pumps, which are of a new and improved type of the vertical piston marine pump, fitted with relief valves. They do their work well and silently. The engine room auxiliary pumps, as well as the distillery pumps, and pumps for moving the turrets and training the guns, are all driven by Dow engines.

A DEPARTMENT OF IRRIGATION ENGINEERING AT UNIVERSITIES.*

By C. E. Grunsky, C. E., Mem. Tech. Soc.

The practical irrigator of the West has to an unusual extent been thrown upon his own resources. Experience has been his teacher. The methods he employs in the cultivation of his soil, in the application and control of water, are generally the direct outcome of local experience. If methods are at fault, if his practice be bad, he knows it not. He looks to the immediate results, and if these be satisfactory, he is content. He may be doing himself untold injury, as when by systems of irrigation which involve upward movement of moisture from subsoil to surface, he causes an accumulation of the dreaded alkaline salts at the surface; yet he remains ignorant of the cause of the deterioration of his soil and continues the bad practice. Even when he recognizes the causes, he looks in vain for reliable authority as to the best remedy. Copious irrigation very often causes so great a rise of the water-table that drainage of soils becomes as important an element in the cultivation of crops as irrigation itself. The irrigator needs instruction and advice on this point; where shall he get it? Methods of irrigation should always be adopted after mature consideration, and

*Read before the Technical Society of the Pacific Coast, June 3d, 1892. Reprinted by permission.

should be dependent upon the available "head of water" upon topographical conditions, such as slope of the ground's surface, etc., upon character of soil and subsoil and the nature of the crop to be irrigated. It is not only important to adopt the best method of applying water, but it is equally important to irrigate at the right time and to avoid excessive use of water. The question is frequently asked and not easily answered : "What shall be the general method of irrigation when this canal system is complete?" In California accident has often shaped the answer to this question. Where the water-table was readily affected by the water sinking from canals and ditches, as in the King's River Delta, the method of controlling water-table elevations has found general acceptance ; yet even today most of the irrigators in that section generally attribute the wetting of their soils to lateral horizontal percolation from their ditches. Wild flooding, or the spreading plan of applying water in the Kern River country, was soon found to be wasteful of the supply, and expensive by reason of the great amount of labor required to control the water. It led to irrigation by flooding in contour checks, which method is admirably adapted to certain conditions of water supply, and to localities where the ground's surface has a fall of less than 20 feet per mile. Elsewhere, on surfaces naturally smooth with very light slopes, rectangular checks have been successfully substituted for contour checks, but these might prove failures under other conditions or in other localities. Furrow irrigation in all its forms, with and without drainage, has found application in many parts of this State, but its introduction on the Canal Farm, Merced County, on a large scale, early in the history of irrigation in San Joaquin Valley, proved a signal failure.

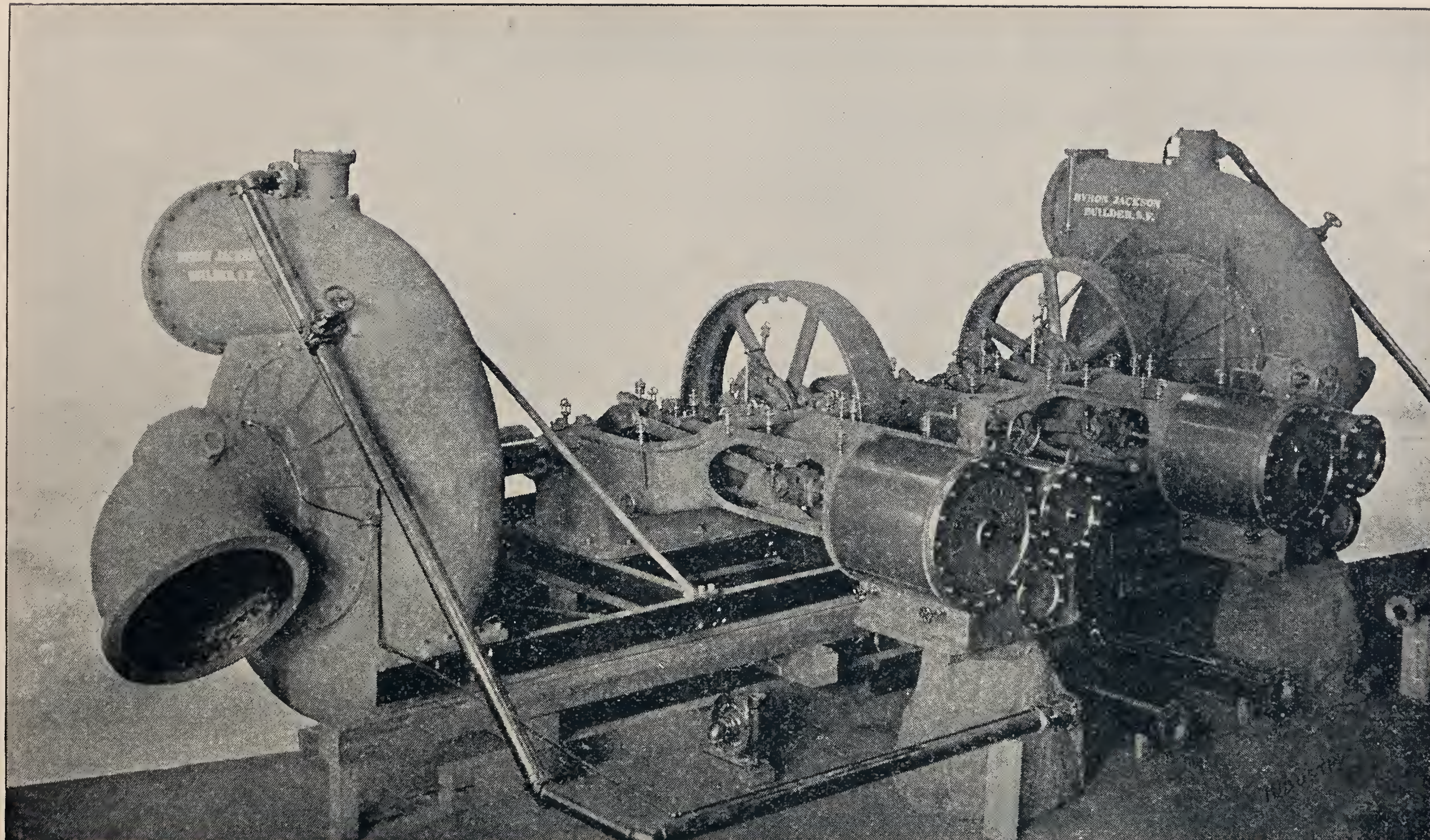
Where water for irrigation is limited in quantity, special precautions must be taken to avoid waste, and oftentimes only those portions of the soil are wet, where moisture will produce greatest benefits. A special study of conditions becomes necessary to attain the best results. Not less important than the question of method of applying water to land, is the study of soil treatment after water has been applied, and the frequency of irrigation under various conditions of soil character, depth of soil, topography, and crops cultivated. In determining what shall be the method of water application, or the practice of irrigation, the element of cost must be taken into consideration, cost of water, water rates or canal management, cost of ditching, cost of land preparation, cost of applying water, etc.

The constructing hydraulic or irrigation engineer of today is not expected to be a practical agriculturist or irrigator, much less a scientist: He is rarely qualified to give reliable advice on all these matters, even should he be called on to do so. His training is defective and provision should be made to remedy the defect.

The dissemination of thorough information on all these points, in the light of experience of irrigators in all parts of the world, not alone in one locality, or throughout one state, is desirable. Scientific investigation, study, and instruction are necessary. Such investigation, instruction and dissemination of useful information should be in charge of a properly constituted department at one or more of the universities of every state in which irrigation is practiced. In matters of this kind our universities should take the lead. They should be thoroughly equipped, as it is their especial province to point out and make accessible the lessons of experience that may be of special value for the advancement of human welfare.

The departments of Agriculture or Irrigation Engineering, as already established in Utah and Colorado, are devoted to work of this character. In no state is the need of such a department more keenly felt at the present time than in California.

Matters of purely agricultural interest, with irrigation in its bearings on agriculture as a secondary feature, are well looked after by the agricultural department of the State University at Berkeley, but that department should be supplemented, or combined with another, in which the engineering features of canal construction; control of water; development and storage of water; measurement of flowing water; water distribution and apportionment; loss of water in transit to lands, by percolation and evaporation; canal management; methods of irrigation and drainage; soil examinations; effect of irrigation on soil, climate, health and all kindred matters; can be made a speciality. Such a department might well be placed in charge of a professor of irrigation engineering, and it would certainly be as popular, as it is necessary for the proper development of our resources. I desire to suggest the establishment of such a department at a University of every state in which lands are irrigated, and particularly in California. It would be of immediate utility, and would result in the training of young men as specialists in the direction in which we at present see the greatest possibilities for development; in the direction of a change from ranching on a large scale, to the intense cultivation of the soil in small tracts by the contented farmer.



RECLAMATION PUMPING PLANT.—BYRON JACKSON, SAN FRANCISCO.

RECLAMATION PUMPING PLANT.

BYRON JACKSON, SAN FRANCISCO.

The plate on the page opposite is made from a photograph taken in the works of Mr. Byron Jackson, of this City, from a large pumping plant just completed for California Reclamation District No. 150. The machinery is to be erected on Merritt Island, in the Sacramento river, Yolo county, and has been constructed under instructions from the district engineer, Mr. George B. Greene, C. E., who is also one of the directors of the district.

The plant, as will be seen, is dual, consisting of two complete centrifugal pumps, having discharge pipes 30 inches diameter, each driven by a separate compound condensing engine of 125 horse power. The capacity of the pumps is from 30 to 50 thousand gallons per minute, or 10,000 tons an hour, against a head of 20 feet, which will be an extreme for the intended purpose.

The air pumps and condenser, not shown in the plate, are very elaborate and complete. They are also dual, the pumps being of the bucket plunger type, brass lined throughout, and made accessible in all parts. These pumps stand in front of the main engines, receiving the open connections seen in the plate.

The arrangement of the main pumps permits their being coupled and driven together ; either operated separately by its own engine, or either pump can be driven by both engines, or both pumps by one engine, so the adaptation is complete for working against low heads, or in case it is required, against high heads to 40 feet or more.

Dividing a plant of this kind into two parts provides for all kinds of circumstances in working, besides for ordinary purposes furnishes a "relay" of machinery in case of accident, and we are of the opinion that it is expedient, even for much smaller pumps and engines, than those shown in the plate.

The circumstances of use present wide variations. When the river is high, the head to be operated against may be from 16 to 20 feet, but when the river is low, or at a medium stage, the head being only the difference of level between the water in the "sump" and at the discharge, may be only five to ten feet. This difference of head is, in the present case, provided for by extending the discharge pipe down to low water and depending on siphon action in the outer leg of the pipe to balance a corresponding part of the lift on the inside.

This method is a common one in Europe, especially for earth dikes or embankments, and when it is desirable to erect the machinery above the flood level. Referring further to the present plant, the steam distribution for both the initial and expansive cylinders, is performed by a single valve placed as indicated by the circular covers between, or below, the cylinders as shown in the plate.

The distribution thus obtained, is without any sacrifice of what we will call "functions," and at the same time avoidance of half the valve gearing and other details required when each cylinder is provided with a separate set of valves.

The main frame as seen, is made of wrought iron channel bars, riveted together. These are to be buried in a solid bed of concrete, which also extends to the front to receive the engines, the whole forming a level floor, flush with the top of the framing. A foundation thus made presents advantages over cast iron bed plates bolted on top of a foundation, and is cheaper in construction.

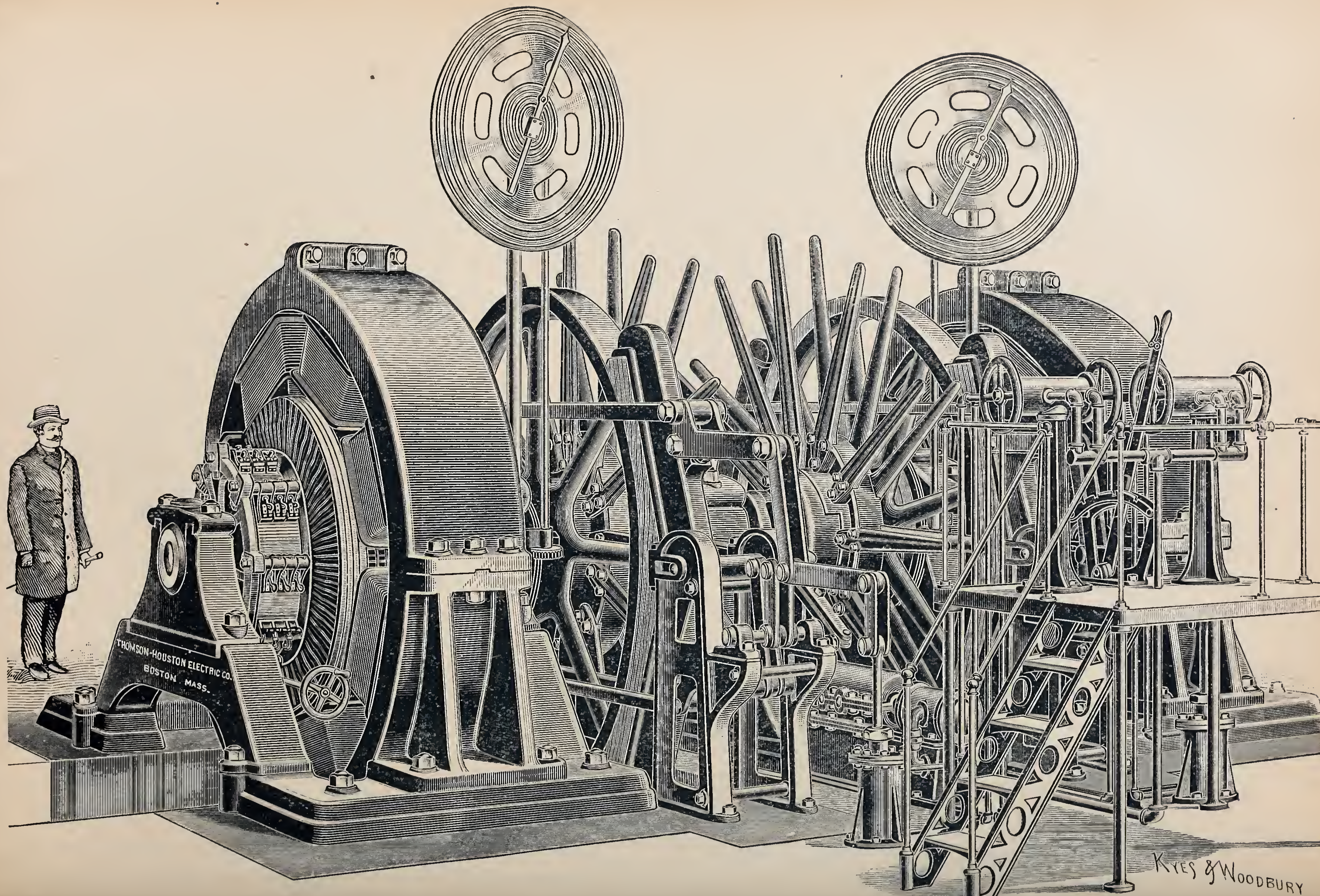
There will be critical observations and experiments with this plant, when it is set at work, and we predict an efficiency that has not been exceeded. The work is well done, but without any "finish," which is an objection for a pumping plant of the kind, where paint should be applied on all surfaces wherever possible.

The scheme reflects much credit upon both Mr. Jackson and the district engineer, Mr. Greene, especially in respect to a remarkable economy attained in first cost, without sacrificing anything in efficiency and endurance.

The air pumps and condensers we hope to illustrate in a future number.

A PIPE LINE FOR COAL.

Mr. W. C. Andrews, of New York, proposes to convey coal in a pipe line, and the scheme is by no means as chimerical as may at first appear. The coal would have to be pulverized at the mine, and there is a question as to any loss by that, because a good deal of coal has been pulverized for economy of use, and as fuel or power would be cheap at a coal mine, there is no great impediment to pulverizing. The fine coal would have to be mixed with water, but this would soon drain off from a dump and leave the "culm" in good order for compressing, or use. The system would have to be a gravity one. So long as the pipes have slope enough to keep up a strong current there will be no clogging, but to force the current by pressure, as Mr. Andrews proposes, will no doubt lead to clogging—a thing that happens in conduit pipes whenever there is opportunity. The amount that could be conveyed would be enormous.


THOMSON-HOUSTON ELECTRIC CO.
BOSTON MASS.
KYES & WOODBURY

ONE THOUSAND HORSE POWER ELECTRIC HOIST.

THE THOMSON-HOUSTON CO., BOSTON.

The drawing on the page opposite will look familiar to engineers and mining men, except as to the immense electric motors mounted on the main shaft. The design is by Mr. E. H. Booth, formerly of this City, and now with the Thomson-Houston Company, as an engineer in the mining department of the Company's business.

Reasons for the employment of electric motors for large hoists, aside from their being situated where direct steam or water power are not available, are given in the following descriptive matter sent with the drawing:

"The rapid hoisting of heavy loads from deep mines by the direct application of the power to the reel shaft, without the intervention of gearing, offers the most favorable conditions for the use of the electric motor in hoisting work. Much greater economy can be shown in the use of power, while a high hoisting speed can be safely and easily attained—a matter of importance where large quantities of ore are to be handled. Herewith is illustrated a direct-acting electric hoist, using flat wire rope, operated by two multipolar type motors, one on each end of the reel shaft, each capable of developing 500 horse power or having a combined output of 1,000 horse power. This hoist is designed to raise a load of 10,000 pounds, exclusive of rope, from a depth of 2,500 feet in one minute. Of course for hoisting and lowering men, or for other purposes, any desired speed can be obtained at the will of the operator. Lowering can be done under complete control of the motors and without the use of the brakes, when desired. Brakes of a very powerful and effective type are used, being drawn together by rods above and below the reel shaft, so that all parts move in parallel lines, distributing the wear equally on the brake shoes and applying the pressure at two points in each shoe equally distant from the center. The shoes are also pivoted at the center, so as to quickly adjust themselves to the faces of the brake wheels. The clutches are of the jaw type, that portion of the shaft upon which they slide being hexagonal in form. Both clutches and brakes are operated by cylinders using compressed air. A small air compressor driven by an electric motor is placed at the center of the hoist, supplying air for this purpose. The compressor requires no attention whatever, being automatic in its action, stopping when the pressure in the receiver forming its base reaches a certain point and operates entirely independent of the hoist. Two sets of valves actuated by hand wheels, one for brake and one for clutch, are placed convenient to the operator on each side of the center of the hoist, each set controlling the brake and clutch on its side. A powerful, reliable and positive means of operating both clutches and brakes is thus provided, requiring practically no exertion on the part of the engineer.

The extreme compactness and simplicity of this machine, as compared with direct-acting hoisting engines, fitted with their complicated cut-off valve gear, will at once be noted. Only about one half the space is occupied as by steam hoists of the same capacity, insuring a considerable saving in buildings and foundations alone, while the economy of the electric motor in the use of power, makes its application to direct-acting hoists, requiring large power, of the utmost importance in a commercial sense."

A WARNING TO THE PUBLIC.

Prof. Hilgard, of the University of California, sends the following in respect to the "Ohio Fruit Company's California Cold Process for Preserving Fruits, Vegetables and Liquids:"

It seems that a quiet but active canvass is being made in this State, and probably elsewhere, under the above caption; and the circular is headed by a notice that "Anyone printing or selling directions not obtained from us will be prosecuted to the full extent of the law." "Compound Extract of Salyx" is the sonorous name under which the alleged new nostrum is advertised.

The name of this "Compound Extract" is incautiously suggestive of salicylic acid. An examination of the sample fruit distributed by the canvassers accordingly shows, in the liquid around the fruit, one third of one per cent. of salicylic acid; which, of course, is well known to preserve fruit, as well as other vegetable and animal matter, but is better adapted to the preparation of show specimens than to preserve for human consumption. Doubtless there are persons who may for some time take such doses of the well known preservative with impunity; there are others with whom its use would in a short time create very serious disorders of the digestion; and there are those whose digestion is wholly arrested when such "preserves" are eaten.

Anyone is at liberty to take his choice as to which of the above classes he considers himself as belonging, and may take his dose of medicine with his dessert if he chooses. But should anyone desire to do so it is quite unnecessary for him to pay the "Ohio Fruit Company" at the rate of eight dollars a pound for what he can get at retail for one dollar and a half. Nor need he be alarmed about the fruit company's threat of prosecution. The use of salicylic acid (elsewhere forbidden by sanitary regulations) is guarded by no patent, and never has been. That of "Coffee C" sugar, prescribed by the company, certainly is not. All are at liberty to sweeten their fruit according to taste, and to spice it with the antiseptic acid without asking leave of anybody. E. W. HILGARD.

Berkeley, Cal., June 17th, 1892.

PEABODY'S VALVE GEARS.

In our review columns will be found a notice of the book above, and remarks upon the author's power of description. The following, culled from the work, will be found to contain a "genesis" of the subject of engine valves in an unusually concise form.

"The valve gear of a steam engine consists of the valve, or valves, for admitting steam to, and exhausting steam from, the cylinder of the engine, together with the mechanism for giving motion to the valve, or valves. The discussion of valve gears is therefore of a fact kinematics or mechanism ; the extent and importance of the subject, make a separate presentation of it desirable. The larger part of valve gears derive their motion from one or more eccentrics ; of such gears, the plain slide valve is the simplest. Other valve gears are best studied after an examination of the plain slide valve, since they accomplish the same results, and by analogous methods.

The valves of locomotives, marine engines, and other reversing engines are commonly controlled by a mechanism called link motion; this mechanism has also the property of giving a variable cut-off. The mechanism consists essentially of two eccentrics, one for full gear forward, and one for full gear backing, together with the eccentric rods and the *link*. The eccentric rods are attached to the link, at or near the ends, and the link is slotted or otherwise arranged to receive a block on the end of the valve spindle, on a radius rod, or the end of a rocker, as the case may be. The link motion takes two forms ; in one, known as the Stephenson or shifting link, the link is moved on the block, to reverse the engine or vary the cut-off; in the other, known as the Gooch or stationary link, the block is moved in the link to accomplish the same object.

A plain slide valve, set to give an early cut-off, is liable to give either an excessive compression or an early release, or both. A single valve under the control of a gear that gives a variable cut-off, such as a shifting eccentric or a link motion, is open to the same difficulties ; and in addition the compression varies with the cut-off though to a less degree. For a stationary engine a large compression may be undesirable, and a varying compression is always so. To avoid these difficulties two valves are frequently used ; one, called the main valve, has an unvariable motion, and gives the admission, release and compression : the other called the cut-off valve, gives the cut-off only, which may be varied without affecting the other events of the stroke. The cut-off valve may be placed in a separate valve-chest, or it may be placed on the back of the main valve, thus giving rise to two separate types of double valve gears. It is important to obtain a clear conception of the principles of double valves, and then all existing forms of double valve gears may be readily understood, and a gear for a given purpose may be easily designed, or else it may be shown that a satisfactory design is impossible."

EXTRACTS FROM A NOTE BOOK

[BY "TECHNO."]

No. XVI

ON DRAUGHTING——SWEDISH METHODS——EUROPEAN SHOP PRACTICE. AN ENGLISH PLAN FOR FORGING SHEETS——HOW TO DRAW A DUMP CAR——SWEDISH INK PALLETS——LUBECK STEAMERS.

————— The present is as good a place as I will find in these notes to set down some views on draughting that have come up since we landed in this older country. Here in Sweden especially, there are some points of interest to one who has worried for months, to know just how machine drawings should be made, as to the scheme, the amount of tinting, coloring, and daubing that should not be employed, and out of it all, with some aid from my uncle, I have arrived at the conclusion for one thing, that I know very little about the subject. Here in Sweden the drawings are the principal part of a thing to be made. The art is a congenial one to the modern Swede, who, very much unlike his ancestors, has become scholastic, wears gloves and glasses, and is effeminate. He is all the time speaking of his humble country, and all the time thinking it is the greatest country in the world, peopled with an exceptional race. I do not like to criticize in harsh lines a country and people, the best I ever hope to see, but all the world has faults, and here there are the objections named of a tendency to scholastic pursuits with a kind of contempt for the practical part.

My Uncle, who sees everything, and forms opinions about everything, says: "These Swedes of our day are an example of the reversal of extremes. People never stop half way, they slop over, so to speak. The descendants of those hard-headed old pirates that once gloried in privations and exposure, have gone to the other extreme and do not even have the manly games, such as hammering each other in the face, smashing their fingers at ball games, breaking their legs at foot ball. They caper nimbly to the notes of a lute and would all be instantly smashed, by Charles XII, if that old chap would turn out of his grave for a second term."

This, however, has nothing to do with draughting, except the national trend is to do more draughting than hard work. It is well done—too well done, is a waste of time and has no application in construction, indeed rather the reverse. In England the art is strained the other way—is pure utility, and, as I believe, as nearly right as can be. They commonly use white paper, that is, paper that was white at first, pencil in the work and then trace the sheets in a clear manner and pile the original sheets away as lumber or destroy them. The lines are clear, in the right place, just enough of them and no "mistakes." No one can describe what is meant further than to call it practical and sufficient.

Here in Sweden it is common to work from a center line, each way, and not uncommon to "figure from a center line," that is, give dimensions from the axis, which is a piece of super-refinement to bother workmen. Dimensions are laid down from the scale by measurement, and not made up as is common in England and America, mainly by computation. There is besides no commercial fitting in of things to save expense, and as to time, that is not considered, drawing being the main part.

The cost of construction, even at the low wages paid and long hours worked, is more than in America or England, and as the workmen seem pretty well skilled, I imagine that most of the prime cost account lodges in the draughting and counting rooms, where there is usually a force about equal to the one in the shop. The methods are plodding, and as they say in England, are "provincial," in so far as small implements and processes, but the work done is good, and I will say right here, that no bad work has been seen since we left home, except what is called merchant work in England, and that is only rough—very rough. In Belgium, Sweden and Germany, indeed all over, there seems to be in iron fitting a tendency to extreme exactness and good finish.

To continue the draughting matter. I remember a story of my Uncle's, relating to a skilled draughstman who found himself stranded "out west," and made application for work at a jobbing works, he came across. He worked off a small sheet in his best style, and handed it in as an example. The firm owners were much pleased and astonished, but doubted if their people could understand such fine drawings. They had some dump cars to make, and wanted a drawing for that. The applicant was equal to the occasion and said he would draw the work without charge. He went early in the morning, hunted up a web of 52 in. Manila paper, borrowed a trestle board from the pattern maker, and a framing pencil from the carpenter. In an hour he had ready a drawing, full size, fearfully and wonderfully made; figured with a blue pencil!

The carpenter would not wait until the owners arrived to inspect the drawing, but carried it off *vie et armis*, declaring it was the best drawing he had ever seen. The owners were much pleased and the tramp draughtsman was at once "installed."

Between the first and second drawing there is a wide range of degree. Both extremes are right ; so are the intermediate grades, and in finding out and adapting lies the skill that owners want in a draughting room. Professor Durschnitt taught us the higher method, and left us helpless so far as pencil sketches on wrapping paper, a kind of drawings necessary in all machine works.

In England they have a method of taking out forgings, that commends itself. Some one handy with a pen, sketches the forgings, free hand, or without much attention to scale, with copying ink. The sheets are then put into a book and press copied, the original sheets which are merely foolscap paper are sent to the "smithy." The drawings thus made look wonderfully well. The figuring is "writ loud" and very plain and to the "forging" size, instead of, as is common and also unreasonable, leaving a smith to allow for finishing. He is not supposed to be skilled in that matter, moreover does not know where pieces go, and should never be bothered with making out finish sizes from rough dimensions. I was much impressed with this method of laying out forgings, and believe it to be a great step in advance of the old forging sheets, and much cheaper, also more systematic. At a large works in England they let us examine one of the forging books. It was like a ledger, indexed, and in no case did the forgings for one machine require more than a page. There being no scale followed, large pieces are condensed and small ones enlarged. The figures set all right, and such figures I had not seen before. They were in imitation of roman type and clear enough for a blacksmith !

In Sweden there was noticed a peculiar kind of ink dishes that call for notice. They consisted of a metallic box, pewter I think, filled with red wax, and a curved glass dish, like the crystal of a watch, pressed down into the wax when it was soft. This makes a good strong job and wonderfully neat ; but that is not the main point. When ink is to be made they breathe on the bottom of the dish to dampen it and then rub the ink without water until it is complete as a "paste," which is then thinned with water. One would think that under some conditions there would not be enough moisture from the breath, perhaps not, I describe what was seen.

——————The steamer down the Baltic was all my Uncle promised, and something more. The engines were new and wonderfully well made, the feathering paddles made no jar and could scarcely be heard. The boat was clean, swift, and orderly. The food was good, or rather was everything wanted, except the "smörgosbord" which is imperative in a Swedish meal. It means a kind of preliminary meal, eaten at a separate table, and consists of various odds and ends, such as anchovies, salted vegetables, caviare, hard bread, butter, bits of cold meat, and mainly a glass of "bränvin" (burning wine) a kind of native brandy, corresponding to German "Kümmel." It is a curious custom, easily learned, and has the distinction of a name for which no etymology could be found.

We came to Lübeck in good time, and of this I will write farther on.

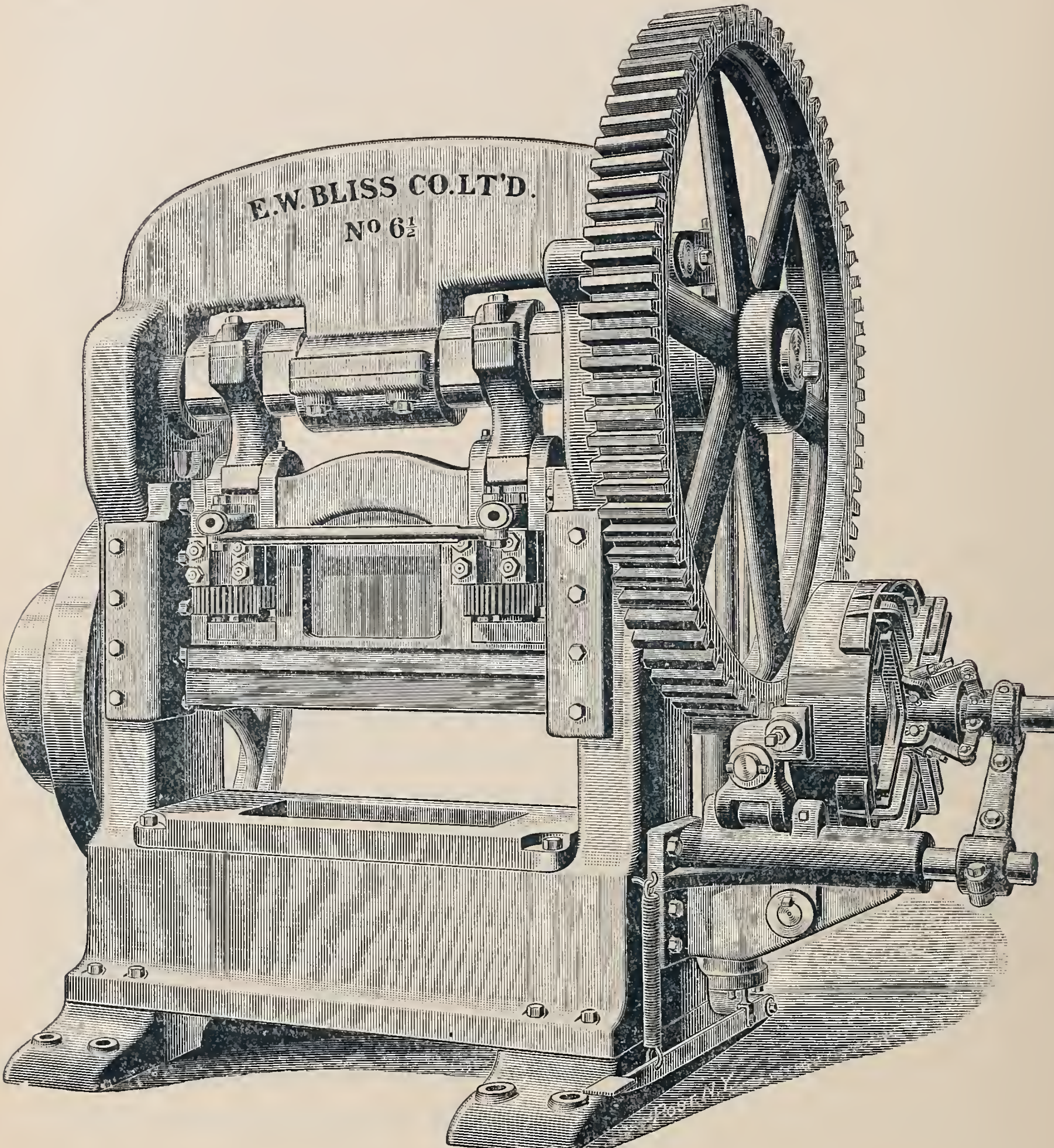
(To be Continued.)

FERRO-MANGANESE BRONZE.

Mr. E. F. Jones, of this City, a well-known foundryman, when in Europe some time ago, looked into the subject of ferro-manganese bronze, and arranged to act as agent here for its importation. Finding that the duty on the metal prohibited importation, he set about making experiments here for producing it and sent some specimens to the University of California, where tests were made and the following table prepared by Professor F. G. Hesse, and the superintendent of the machine department, Mr. J. A. Sladky. The quantities in the fifth column are remarkable, showing an enormous tensile strength.

The metal, examples of which have been sent here, is homogeneous throughout the fracture, and on the surface presenting a much finer appearance than the imported ferro-manganese bronze, of which examples were also sent for comparison.

	Size.	Cross Section.	Elongation per ft.	Breaking Strain.	Crushing Resistance	B. S. per square inch.	C. R. per square inch.
Cube A	0.92″ ht.	0.4935″			25700		52077.00
Cube B	0.91″ ht.	0.4760″			27200		57142.65
Bar A		0.50″		15900		31800.00	
Bar B		0.50″		14200		28400.00	
Rod F	0.53″ dia.	0.2198″	2.25″	15200		69151.09	
Rod E	0.52″ dia.	0.21038″	2.10″	13950		66302.28	



FORGING PRESS WITH AUTOMATIC FRICTION GEARING.

THE E. W. BLISS COMPANY, BROOKLYN, N. Y.

The drawing above, furnished by the E. W. Bliss Company, of Brooklyn, New York, answers graphically a question that has many times been asked; that is, why punching, shearing, forging and other powerful machinery of the kind is thrown into motion abruptly by means of positive claw clutches. The custom has been, the world over, to mount the first mover of such machines loosely on the shaft, and when a stroke was to be made, a "through-pin-clutch" was thrown in, causing a destructive blow on the parts, disagreeable to hear and unmechanical in nature.

In the case of forging presses this might be accounted for by a desire to retain some of the qualities of a steam hammer with the objections that apply to concussive action, but the true answer to the problem is, no doubt, that "it was always so."

It is a pleasure to observe that the most prominent firm in this manufacture, and for that reason the most likely to do so, have so far abandoned the "percussive" clutch as to apply to their machines frictional starting devices, as shown in the drawing and have thereby earned commendation from all those who employ machine tools of this class. The makers send the following description :

"The construction of the automatic friction clutch which avoids these difficulties, will be understood from the annexed illustration of a press adapted for very heavy forming, forging and punching. A pressure on the foot treadle shown releases a weight which actuates a powerful friction clutch. In order to avoid too sharp an action of this weight it is connected at its lower end with a dash-pot.

After the shaft has made one complete revolution a cam releases the friction clutch, bringing into action at the same time a brake, and thus stopping the slide at the highest point of the stroke.

The large gear wheel, instead of revolving continuously, is, with these new clutches, keyed on to the shaft, and at a standstill until the clutch is thrown into action. This constitutes an additional advantage in avoiding wear of the shaft and wheel.

There is nothing about these clutches which is liable to get out of order, and for whatever wear may be occasioned by continuous use easy means of compensation are provided.

The press shown is one of a series of 11 sizes. It weighs about 25,000 pounds, and has 54 inches between the uprights, thus adapting it for gang punching, the operation of cutting and forging dies set side by side, and long bending dies."

The employment of frictional devices for stopping and starting heavy machinery has always been known to possess the functions required, that is, the application of a cumulative force in starting, and a sudden release in stopping. This function, to so call it, was especially desirable when the momentum of running parts had to be called into action, as in the case of punches, presses and so on, but the limitation of the method was found in the frictional mechanism itself, which could not be made durable.

Lately, however, there has been great advances made in the construction of friction clutches, and we imagine that, in the case of the E. W. Bliss Company, it was the want of durable devices of the kind that delayed the application of frictional starting gearing on their heavier machines. The devices shown are the subject of pending patent applications.

NEW ENGINE VALVE GEARING.*

Mr. J. H. Hoadley, of the California Engineering Company, representing the Wheelock Engine Co., of Worcester, Mass., presented and explained, at the last meeting of the Technical Society, a set, or system of engine valves, shown below.

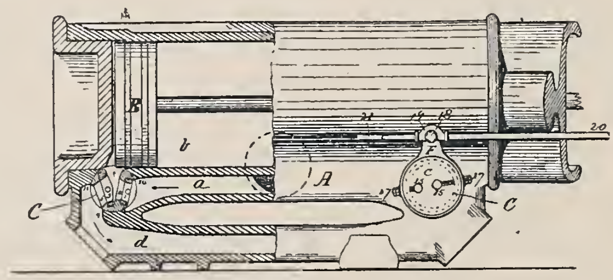
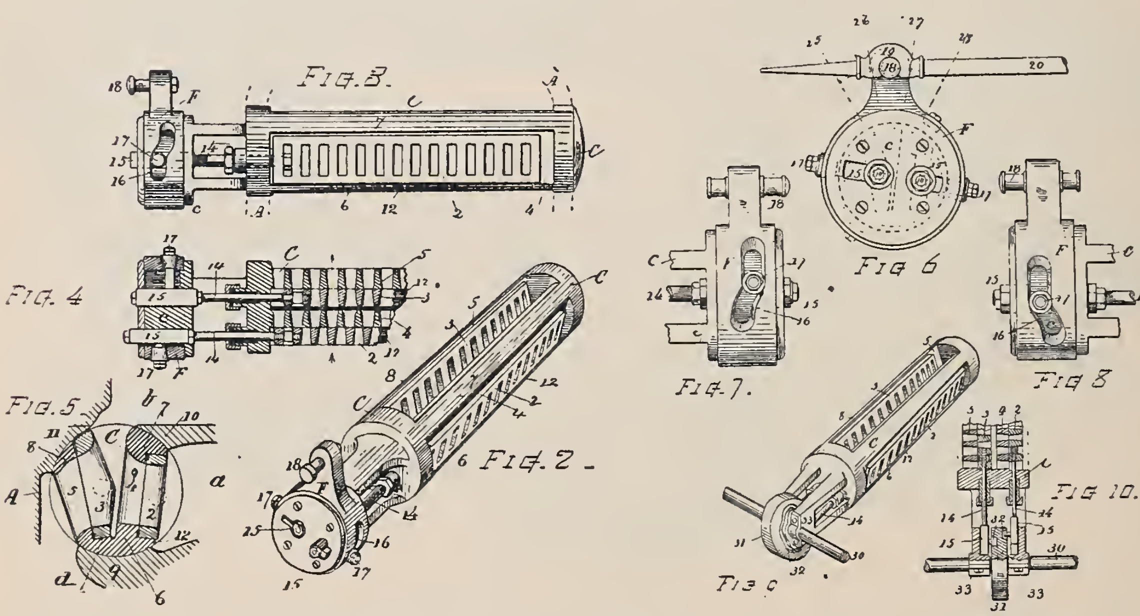


Fig. 1



New Wheelock Engine Valves.

These valves are illustrated in the drawings herewith, in which :

Fig. 1 is a part side, part sectional view of an engine, cylinder and valves, illustrating the nature of the invention.

Fig. 2 is a perspective view showing, separate from the cylinder, the skeleton plug or valve-seat frame, with the inlet valve and exhaust valve.

Fig. 3 is a side view of the same.

*Before the Technical Society of the Pacific Coast, June 3d, 1892. Reprinted by permission.

Fig. 4 is a horizontal section through one end of the skeleton plug, valves and valve-operating devices.

Fig. 5 is a transverse section through the valves and valve seats.

Fig. 6 is a front end view of the valve-operating mechanism.

Fig. 7 is a side of the rocker, showing its cam or groove for working the exhaust valve.

Fig. 8 is an opposite side view, showing its cam or groove for working the steam inlet valve.

Figures 9 and 10 show a modification in the cam mechanism, or operating parts, adapted for engines wherein a rotating shaft is employed, instead of an eccentric and rod for imparting movement to the valve-mechanism.

Mr. Hoadley's remarks were as follows :

"This valve was invented by Edward K. Hill. It is of new form and construction entirely. The valves are made in sets complete. This frame contains the entire valve mechanism. The cut-off and exhaust valve are on one side, and the live steam on the other side. In the Corliss engine the valves are at the four corners, so to speak ; these are at each corner below the piston. The Wheelock engines, as made since 1885, were mounted on a single block, an individual valve for each block, the valve moving up and down by means of links inside the cylinders.

The present valves are of the gridiron pattern. They give the greatest port area of any valve system. While the Corliss only has a port area of 7½ per cent. of the cylinder area, this engine gives about 18 per cent., which permits a full throttle pressure on the piston. No engine has ever accomplished that before, and of course this engine has ranked itself among the first in economy.

The main thing that this system was prepared for is marine work. A complete set of valves can be carried on board a steamer, so that an engineer can drive the old valves out and put in new ones without changing anything ; or he may easily remove the valve system and inspect or repair it, and replace it in a very short time.

This does away entirely with dash, or vacuum pots, that are necessary for their automatic engines. The valve is thrown back by steam pressure on the valve stem. There is a small spring in this model for the purpose. In a working engine this spring is not necessary.

For stationary work this engine is very desirable, especially for electrical apparatus. The valves will permit one hundred and fifty revolutions a minute, a speed that has never been attained by any other liberating valve gear; the highest I have known is one hundred and two. With this valve gear, if you will notice, there is no movement required for the hook to catch hold of the block, as it merely drops about one eighth of an inch.

The importance of this system is that it places makers of steam engines upon the same basis. It becomes a matter simply of quality and workmanship. All engines can be made to develop the same economy in regard to steam consumption. Manufacturers can buy the valve systems, bore the holes in the cylinder castings and press the valves in. The entire systems are all made by one concern, and furnished to different makers. There are six firms now that have contracted for the valves, intending to change from the Corliss method to this.

The importance of the cam movement is that these valves are never moved under pressure. It is not very easy to explain this without a personal observation. (Explaining on model.) While this exhaust port is moving, you will notice that the other does not; the pressure is on that valve now, and we see that the exhaust port is opening, letting the steam out of the cylinder all the time the exhaust port is open, and the live steam valve is stationary. The exhaust here is closed, and the live steam valve just ready to open. Now, while that opens on this side, the exhaust port has just been closed, and is stationary, so it is not moved under pressure. The consequence is that the valves operate very lightly and the friction on the engine itself is nominal.

Another important point is that this engine regulates itself perfectly, something I don't think any other engine has yet been made to do. The governor to give a full opening of the port has only to move three eights of an inch, and the least I have ever seen on a Corliss engine has been three inches for a full opening, or closing valve.

Another point in this is the securing of a slight throttle pressure, owing to this cam movement. The steam is let out in ample time without creating any back pressure at all on the piston.

There is yet another point: The fact of its being impossible to wreck the engine by getting water into the cylinder. It does not hurt the engine at all to get a flow of water into it, because in the absence of pressure inside — the exhaust port exhausts the pressure on the steam valve — this valve lifts from this side, and allows the water to escape. The valve can be lifted out four inches if necessary.

DISCUSSION OF THE FOREGOING REMARKS.

Q.— "Can you give any comparative figures with Corliss engines as to economy?"

A.— "They will guarantee to excel all other engines five per cent. with this new valve. A comparative test has just been made in the East, between a compound engine of this class and a compound Corliss engine, and it excelled the Corliss 15 per cent."

Q.— "Do you consider the Corliss engine an economical, high-class engine?"

A.—"There are Corliss engines and Corliss engines, according as to how they are made. I do not suppose any automatic engine, so far, has beaten the Corliss engine except the Wheelock. Up to date, these have been the accepted automatic engines."

PROF. GALE.— "I remember seeing a statement some time ago of a Corliss engine in the East running at the rate of 125 turns per minute."

MR. HOADLEY.— "The best that I know of in this respect is one at Providence, R. I., and that ran 102 turns."

Q.— "Is this engine in actual operation in this City?"

A.— "No. The first engines of this class that have been sent to the Coast, are three for the Albion Light and Water Co., at Portland, Oregon. There are two of the old style, gridiron-valve type, in use in the Chronicle Building."

THE PRESIDENT.—"I call upon Mr. G. W. Dickie for his opinion upon this subject."

MR. DICKIE.—"One of the remarks that has about 'paralyzed' me in regard to this subject is this: 'That the builders of marine engines would only have to bore four holes.' Now I hope that will not succeed. I will go out of the business when I merely have to bore holes, and receive the rest from the valve makers.

This valve, I have no doubt, is very good under certain conditions and for certain purposes. It may find a place, perhaps, for small engines. For marine purposes, and for very large powers, I do not think that that kind of mechanism is sufficiently substantial. The mechanism that operates the valve, slot, and roller, I am afraid, would wear rapidly in a very large valve. This system may be carried out in stationary work, but I think it can not be employed in marine work, because the conditions of the cylinders vary so immensely between one revolution and another, at sea in rough weather; and all these devices, which are worked out very nicely, fail at the time when they are expected to be most effective.

I am prejudiced in speaking of this valve gear; I have seen many operated — I don't know how many, and I have tried to do something in this line myself, but, I am sorry to say, I had to give it up. I heard the same assertions made over twenty years ago, that it would only be necessary for a marine engineer to put up a frame work, bore the holes, and some concern will send the valve gear, and one engine will be as economical as another. I do not think that condition will ever obtain in regard to marine engines especially, that one will be as economical as the other. I have tried to make them alike and have found some economical, and others not, and we could not always tell the reason why.

The facility with which one can insert valve sets is a good point, but I was rather amused to hear that it would be necessary to stop at sea to do that sort of thing. As a rule a valve is pretty bad if you can't get into port with it, and it would have to be very bad indeed before permission would be given to stop at sea and take the valve out to look at it; it would have to be entirely useless before that would be allowed."

Mr. Hoadley.—"I referred to the general work of stationary engineering. I disagree with Mr. Dickie in the matter of the valves not being supplied to other makers, because I think this has already taken place. Competition through the eastern country is in such condition, that it means a great many failures, and a great deal of poor work; and it is putting the very best makers in the United States on a level with the lowest. One noted firm in the East, that I can mention, never went outside of their doors for an order until this time; now they cannot get enough work to keep their facilities employed, and work which they would not have allowed to go out of their place five years ago, they now try to believe is pretty good."

These valves can be made to almost any size desired, and much stronger than the example, (which is for a 12-inch engine), and all the dropping gearing comes away entirely. When arranged for marine use, it is a separate proposition altogether, and it is made very solid and substantial. I have been to sea a little myself. Mr. Dickie says that a valve would have to be very bad before permission would be given to stop. That is so, but if a valve is leaking so badly that several tons of coal are lost a day, it is easy to run with a low pressure cylinder, when a valve can be taken out in a few minutes and another put into place."

MR. DICKIE.—"I think you underestimate the time. In removing a valve weighing half a ton, or a valve of an engine of any size, a few minutes do not amount to much. I tried to get one out tonight at six o'clock. It was not out when I left. Valves are supposed to come out very easily, but when they have been used where there is salt water they are not apt to come out as readily as they went in. Driving metal to metal, it becomes locked together in a manner sometimes very difficult to separate. I have seen valves of the gridiron type—have made some myself—and I have a very vivid recollection of boring the whole thing out. And that, I think, would occur very frequently in a valve set like that, driven in metal to metal, and where salt water is apt to come in contact with metal surfaces."

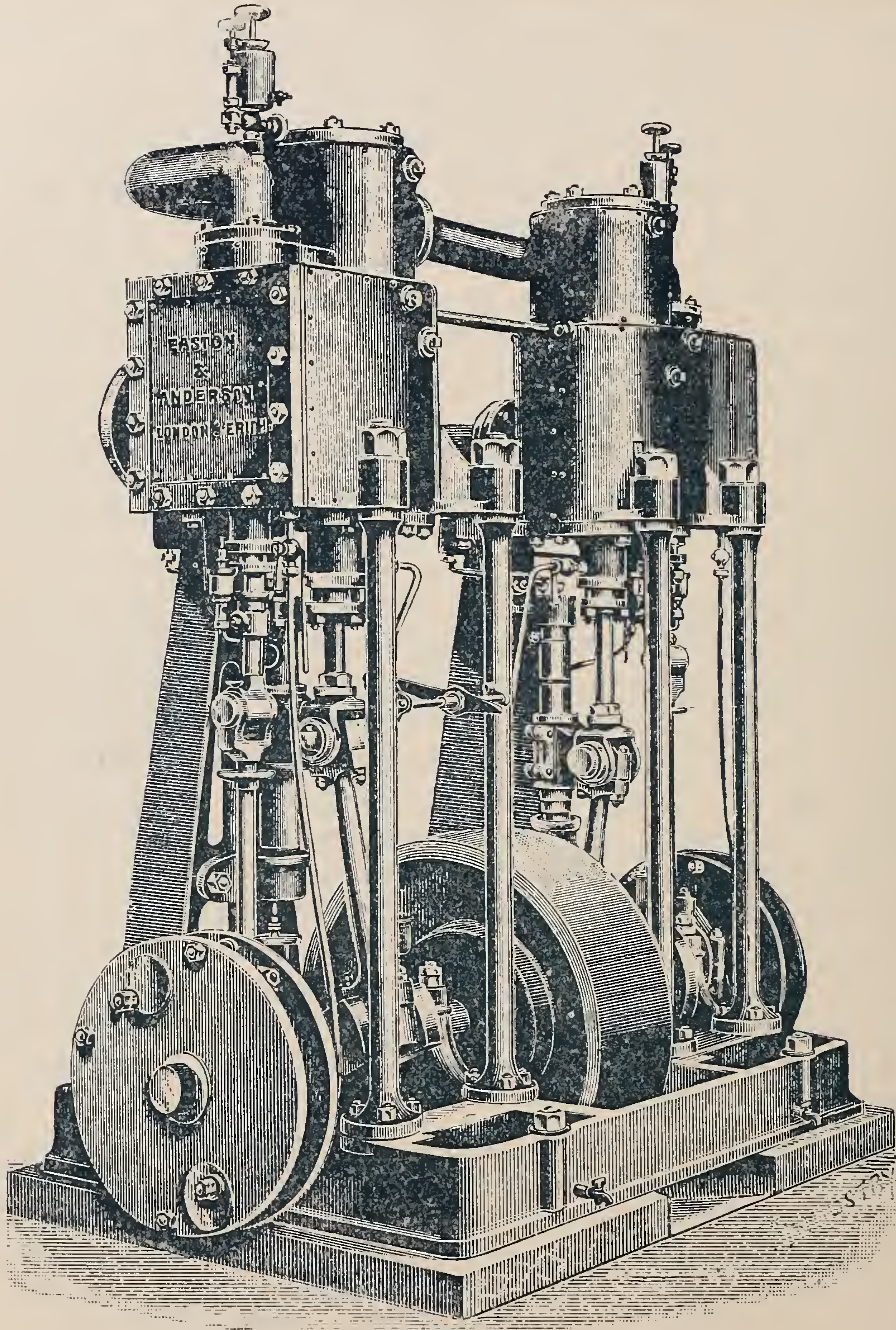
MR. HOADLEY.—"I have had no experience with that valve on salt water, but I have had something to do with probably six hundred of these engines of the old style; that is, the exhaust on one block and live steam on the other block — a valve on each block—and I never had one stick yet, that I could not drive out with a light sledge hammer. Two blows would always take it out. I have never had any trouble at all when the engine was cool. They are bored on a taper and are readily removed."

MR. DICKIE.—"The conditions are entirely different with land engines; there the valves will remain in very much the same condition as when put in; but when they come in contact with salt water, I have met with considerable trouble in removing them. We have no difficulty with land engines, but with marine engines we have a great deal of trouble."

MR. HOADLEY.—"There are several preparations that can be put on them to keep the salt water from attacking them."

MR. DICKIE. — "We have gridiron valves in the "City of Pueblo," built by Cramp, who did not design the engines. They were designed by some one in New York. The engine is economical and has given very good results; but they have never repeated it — I do not know why."

The working model of these valves, above referred to, for a stationary engine of twelve inches bore, can be seen at the office of the Risdon Iron Works, in this City.



HIGH-SPEED DYNAMO ENGINE.

EASTON & ANDERSON, ENGINEERS, LONDON.

The engraving above is printed from a photo-plate made from a wood engraving, the first of the kind that has been prepared for INDUSTRY. It, of course, lacks much of the finish of a wood engraving, and is, in that respect, unlike illustrations that have hitherto been employed, but is a correct representation of the original, and conveys a clear idea of the details and design. We have reproduced the drawing as an experiment, and also to call attention to a novel feature which will be further noticed presently.

The engine is one being exhibited in London under the name of the "Stoker Compound Engine." It is of 60 horse power, and is driven at 450 revolutions per minute. We quote as follows from a description in *Industries*, London, from which the illustration is taken.

"By careful design the steam distribution has been arranged with the view of securing the maximum economy of steam, and the momentum of the moving parts has been reduced as much as possible by making them light, though abundantly strong, and *is counteracted by special arrangements, so that the thrust on the connecting rods is always kept in one direction and the noise from reversal is avoided.* Very ample surface has been allowed in all the bearings, with facilities for taking up wear wherever required, and special attention has been paid to efficient lubrication. Although running at this exhibition with a 'Pickering' governor and ordinary eccentrics to work the valves, this engine is well adapted for regulation by means of crank-shaft governors, which have been so applied to it."

It is the sentence in italics, which we have so distinguished, to which attention is especially called. It will be noticed that there are two plain extensions on the top of the steam cylinders, and it is to this, no doubt, reference is made in the sentence just referred to. If so, it is a copy, or imitation, of the engines made by Mr. M. B. Dodge, of this City, one of which, as our readers will remember, was shown in the last exhibition of the Mechanics' Institute, and which has been previously noticed in this Journal

We were of the opinion, then and now, that the nature of this invention and its importance in high speed engines is not understood here, and has not commanded the attention it merits. Some evidence of this is seen in the application of the method by one of the most famous firms in England.

The trunk extensions of pistons passing into the chambers, seen on the top, reduces the area on the top of the piston, the annulus there being equal to an initial cylinder of a compound engine. The steam, after acting in this annulus, is passed to the bottom of the piston and expanded for the return stroke. This trunk has a further object, it causes a partial vacuum on the down stroke, counteracting the gravity and momentum of the reciprocating parts, permitting high speed without knock or jar. The effect is hard to be understood inferentially, but if an engine, so fitted, is changed from one method to the other by destroying the vacuum in the superimposed cylinders, the effect becomes instantly apparent. The trunk extension has also the advantage of providing a long bearing and guide for the piston.

There is, of course, the objection that the walls of the cylinder are exposed to steam at different temperatures and increased condensation from that cause, but this is a small loss when compared with the countervailing advantages of the system, especially for high speed. The engine shown, if supplied with steam at high pressure could be operated as a quadruple expansion one.

SOLUTION OF THE SILVER PROBLEM.

Mr. C. A. Stetefeldt, the well known mining engineer, whose attention has naturally been directed to the silver problem, in a letter to the editor of the *Engineering and Mining Journal*, proposes a solution of the whole matter, as set forth in the following extract from his communication.

"The United States Government should establish a factory of silver buttons under the supervision of the Director of the mint. It would not be safe to leave this important business to private enterprise, because of the danger of putting buttons of inferior fineness in silver, on the market.

The ball is to be set in motion by providing the army and navy with silver buttons, then the employés of all departments of the civil service are to follow.

No Senator or member of Congress will be admitted to the sacred halls of the Capitol unless he wears a full set of silver buttons.

The President of the United States will decline to receive any caller unless he or she wears silver buttons. Why not? Is a man permitted now to appear before the President without a coat—in his shirt sleeves?

The individual States will at once perceive the necessity of taking up this important matter. The uniforms of the militia will be provided with silver buttons, and all the officers of the State and municipal governments will shine with silver buttons. But the wearing of silver buttons will not stop here. While a law forcing the people at large to adopt this custom would not be constitutional, a much more powerful agent can be brought into requisition, namely, fashion.

Would it be so difficult to gain the aid of a Mrs. Astor or Vanderbilt in this national enterprise? The dudes of New York would take up this fashion with delight and would parade Fifth Avenue in silver buttons, and every respectable dog would bark in a silver collar. How beautiful would the leader of New York's Four Hundred look in silver buttons!

The fashion once established by the leaders of society, every man, woman and child in the United States would cry for silver buttons!

To intensify this desire it would only be necessary to make a law prohibiting persons who have served a term in state prison, aldermen of New York City and Chicago, and members of the California Legislature to appear in silver buttons. No respectable citizen would like to be taken for an ex-convict, or a boodler alderman, or for a member of the California Legislature.

It would be reasonable to assume that every man, woman and child of the sixty millions population of the United States would consume, on an average, ten ounces of fine silver in buttons. This would require 600,000,000 ounces of fine silver, until all demands for buttons were satisfied.

But my silver friends in St. Louis will say that then the consumption of silver will stop, and the old deplorable status will be re-established because it is evident that the new generation will wear the buttons of those who have passed away to the land where dividends from silver mines are not known. This can easily be remedied.

Make it a custom, nay a law, that when a man dies all his silver buttons are buried with him. Undertakers would have to make oath that this had been done, and a violation of the law would make a man's will null and void, and the State would confiscate his property."

LARGE VESSEL.

There is now being built at Port Glasgow in Scotland, a very remarkable vessel for carrying rice from India to Breman, in Germany, for a German firm of rice millers. The vessel is 375 feet long, 48 feet beam, and draws 25 feet of water. The net tonnage is 3,822, and the carrying capacity at least 7,500 tons. There are five masts, with an enormous spread of canvas, that is supposed to drive her 13 to 15 knots an hour, but the sails are supplemented with a triple engine, capable of propelling at seven knots an hour. This vessel, called the *Maria Rickmers*, is less than the French ship *France*, which recently visited this port, but not much less. The *France* is also 375 feet long, and has one foot more beam. It may be noticed that all these large vessels recently built, have been for long voyage service. The *Great Eastern* was by reason of her time in port a failure for trans-atlantic service.

AMERICAN ENROLLMENT.

The New York *Nation*, in commenting upon the recent act of Congress in admitting the *City of Paris* and the *City of New York* to register under the American flag, says:

"The passage by Congress, with scarcely any opposition, of the bill to admit the Inman steamers *City of Paris* and *City of New York* to American registry, is a notable event, and must be considered the beginning of a great reform in our shipping laws and in our commercial policy. The mere fact that the Inman company is required to build additional ships of the same aggregate tonnage in American ship yards, is a very small price to pay for such a concession. It will be impossible henceforth to resist the petitions of other American citizens who own foreign-built ships to have them put under the flag of their own country. It will be impossible long to resist the petition of other American citizens to be put on a footing of equality with foreigners in respect of the ocean carrying trade. What an anomaly and injustice it is which allows British, Norwegian, Chinese, Hawaiian, and all other vessels that come to our ports and fetch and carry all kinds of goods for such freight money as they can get, but denies to our own people the right to own these very ships *unless* they are sailed under a foreign flag. You may own a British built ship and sail it under the flag of San Domingo as long as you please, carrying American products out and foreign products back, but you cannot get the protection of your own country for your property. The negroes of San Domingo can come here with British-built ships and enter into competition with our people in the ocean carrying trade without the slightest restraint, but our own people cannot buy a British ship and get an American registry for it on any terms. The glaring injustice of this discrimination against our citizens must make itself felt ere long, now that Congress has taken *one* step in the right direction. It is said that the admission of the two Inman steamers was due to a galling discovery at the time of the Chilean difficulty, that we had no swift transports capable of being armed. If this is the true explanation it is the only good thing that the Chilean difficulty has brought us."

To this comment may be added that Mr. Cramp will now have an opportunity to construct ships at the same price it can be done for in England, as he claimed he could do in the *North American Review* some time ago. We do not doubt his ability to "construct" ships at the same cost and just as good, but how he can do so out of material at an advance of 80 per cent. or so on British prices and supply ships at the same cost, is a problem.

MEDICAL HUMOR.

In the March number of INDUSTRY there was published a very witty address delivered by a clergyman before the Western Society of Engineers. Mr. Hubert Vischer, C. E., of this City, sends the following as a companion piece to Mr. Haney's address.

It is a post graduate speech by Mr. Frederick Taylor of the New York Stock Board, before the Faculty of the Post Graduate Medical School, of that City, at their annual dinner last year. Mr. Taylor said:

" If you wonder how it is that an outsider like me has been permitted the privilege of a seat with you at this banquet board, I would remark I am not entirely without right to be here, because I have studied medicine; that is to say, once upon a time when I was a young man I attended lectures. If, when you contemplate the color of my hair, you are disposed to locate that time somewhere about the close of the last century — well, you are not very far from right. But no matter just when it was, for several seasons I sat beneath the fluent Dunglison, heard the stately Gross, watched the dramatic Pancoast, followed the metallic Bache, and listened to the unique Meigs — at the same time devoting myself with equal assiduity to billiards, tenpins, boat-rowing, and all other divertisements peculiar to medical students. You've all been there, and I am sure you know how it is yourselves.

As the result of my — labors (!) I ultimately got, I don't say I was entitled to, a diploma in a green tin box, and I bloomed upon the world a full-fledged M. D.

For some time thereafter I consumed much midnight oil in studying maps, looking for a place wherein to hang out my shingle. After mature deliberation, however, I concluded to hang it out nowhere, prompted to this conclusion by the conviction that there was no room for me at the bottom of the profession, and by the suspicion that I hadn't the capacity to climb to the top, where, as Webster says, there is room for everybody.

Since then, gentlemen, I have often thought if I had decided otherwise, how different would have been the fate of some community, and I have often wondered if that community, wherever it may be, ever dreams how close a call it had, and what it has escaped.

You remember the Confederate soldier who, at the close of the war, felicitated himself by the reflection, 'Them Yankees do 'pear to have got the best of us, but I'll be goll durned if I hain't killed as many of them as they did of me.' Well, if there is anything about which I feel sure it is that I would have killed more of any community in which I might have located than they possibly could have killed of me. Perhaps in my decision not to practice I made a mistake. I certainly think so when I look into your faces, so suggestive of all the creature comforts, and so indicative of contentment with the lot of life. But if I did make a mistake I am consoled by the reflection that I erred, as they say Lincoln always did, on the side of mercy — mercy to the community to which I have referred.

Instead of going out into the world looking for patients to devour — to devour my prescriptions — I stayed here, and am associated with the thousand doctors in daily attendance upon a patient, in a white marble building at the corner of Wall Street and Broad.

I dare say, gentlemen, that, out of your combined experience, you think you know all about patients ; but I tell you until you have tackled the patient I refer to you have much to learn, because of all patients that ever bothered doctors that patient is the boss. Like unto your patients in many respects, it is unlike them in that it never dies. Your patients always do, at some time. Your patients all pay you for attendance upon them, except, of course, those from whom you can't collect anything; at least you never pay for the privilege of attending anybody. But it is very expensive at times to wait upon the patient I refer to ; indeed, there have been times when that patient has cleaned the doctors out by the score. But, otherwise than I have stated, the patient is just like yours. It has its good days and bad ones, up today and down tomorrow ; now strong and likely to be better ; again feverish and certain to be lower. It has its time of depression, suspended animation ; death seeming sure, *rigor mortis* set in ; but, as I have said, it never dies ; on the contrary at ten o'clock the next morning it is always as lively as ever, and ready for all its doctors.

And the doctors — in some respects they deserve credit. For instance, their devotion to and concern about their patient. It is no uncommon thing for them to lie awake or to walk the floor all night on account of that patient. Does worry about your patients ever rob any of you of sleep? And in the matter of professional etiquette — why, gentlemen, there is not an instance on record of any of our doctors tampering with one of your patients. Have not some of you, at times, meddled with our patient — to your sorrow ?

But, seriously, I am very grateful to my good friend Dr. Roosa for the invitation to be here tonight, and I am proud of the honor of being permitted to sit with you in the enjoyment of this so delightful feast, because though I know enough, of course, to know that I don't know anything about medicine, I still know enough to appreciate that, of all the great professions, yours is the highest and noblest to which one can devote himself.

I am aware that there are those who hold one other profession higher and nobler; but, while I would not by so much as a breath detract from the beneficence of that profession, I feel that a broken leg or disordered liver occasions more mental and physical discomfort, and demands more immediate relief, than an irregular soul.

The doctor's presence is at times a matter of life and death, and he must be had on the instant, but I have hardly ever known of a case in which the dominie couldn't be waited for till the next morning, unless perhaps it was a case of matrimony, and then the trouble was largely, I think, imaginary. If the contracting parties could only have been brought to see it, neither of them would have lost anything by waiting till the next day.

We might possibly pull through without the dominies, but the conscientious and skillful physician is a vital need of every community. We cannot without the aid of his helping hand scramble over the ropes into the twenty-four-foot ring of life; we turn to him after every round, to make us ready to answer to the next call of time; and though we know he cannot prevent the inevitable 'knock out' that awaits us all, we look to him to put off, to as late a date as possible, the time of our throwing up the sponge.

There are many reasons why you should be very proud of your profession, gentlemen; but I think you ought to be specially proud of it, because, of all the professions, it has, within the last quarter century, made the greatest and most rapid progress. It has been a fad of mine to collect books about the late unpleasantness between the sections, till I have stacked up in my library several hundred volumes on the war. The other evening my friend the Hon. John Jay Knox, while looking them over, turned to me and said: 'I have a set of books I would like to add to your collection, a dozen volumes published by the Government, the medical and surgical history of the war, and yet,' said he, 'a prominent physician told me the other day, to my surprise, that the books have no value except as curiosities, because the medical and surgical sciences have so far advanced since their publication.'

Gentlemen, I do not believe that a statement like that could be made of any other one of the great sciences of the day.

But I have talked as long as I ought to, and have not yet said a word about the text which Dr. Roosa assigned to me. Frankly, gentlemen, the occasion is one of such jollity all around that I don't feel like talking about anything so big and so serious as the toast for which I am put down, and if I did I don't believe you are in the mood to listen to me,

You remember, on the first Sunday after General Sherman had occupied the city of Memphis he was surprised that none of the churches were opened. Forthwith he ordered that on the next Sunday they should all be opened. Whereupon he was waited on by the minister of the First Episcopalian Church, who confessed himself in a dilemma, because the prayer book called for prayers for the President of the Confederate States, and he feared that prayers for Mr. Davis might be offensive to the general. 'Oh! my no,' said the bluff old general, 'not a bit. I don't care whom you pray for. If you want to pray for Davis, do so. He needs your prayers, mighty bad. Abe Lincoln is all right, and he can get on without them.'

Well, gentlemen, I think the country is all right and can get on without speeches by me or by anybody else; and so, without trespassing further upon your indulgence, I yield the floor to the gentlemen who are to follow me, and from whom I know you are anxiously waiting to hear."

THE TECHNICAL SOCIETY.

This Association held their regular meeting on the third of last month at their hall, 819 Market street, this City. There was a very full attendance.

The following new members, having been balloted for, were declared elected:

John W. Gray, Hydraulic Engineer................Oakland, Cal.
Mark B. Kerr, Civil Engineer................San Francisco, Cal.
Prof. Willard D. Johnson, U. S. Geological Survey..Berkeley, Cal.
John H. Wallace, Civil Engineer.............San Francisco, Cal.

Three names were proposed for membership and referred to the Board of Directors for their action.

A communication from Mr. George G. Belmor invited the Society to witness certain tests to be made of a smokeless steam generator, made by the Belmor Smokeless Steam Generator Company, of this City. The Society was asked to appoint a representative to be present during the time the boiler is undergoing the evaporative tests.

The President appointed a committee of three, consisting of Messrs. J. D. Isaacs, C. E. (chairman); Carl Stetefeldt, E. M., and H. C. Behr, M. E., to examine and report upon the experiments.

The following communication was received from the American Society of Civil Engineers:

"The American Society of Civil Engineers has accepted the duty of organizing and conducting the deliberations of division A, of the World's Congress Auxiliary of the Chicago Exposition. The subjects devoted to it are those relating to Civil Engineering.

The meetings of Division A will be held in Chicago, and, it is expected, will take the place of the Annual Convention of the Society for the year 1893. The sessions will be similar in all respects to the ordinary conventions, except that the deliberations will be participated in by engineers from all parts of the world.

Papers will be classified, advance copies, probably in abstract, sent to those competent to discuss them, and every arrangement made to add to the value of the proceedings.

It is not thought desirable to send out invitations promiscuously to write papers; but that the best result will be reached by selecting men to write who have had special experience in particular branches of work, to be followed by discussions from others.

The object, therefore, of this circular is to ask your Society to name one of your members to aid the Committee of this Society having the matter in charge, by the suggestion of persons who are in position to furnish papers, which would be a credit to American engineering and of general interest to the profession.

Prompt action is desirable.

[Signed.] F. COLLINGWOOD, *Sec'y.*

This matter was, by a resolution, referred to the President for answer, and the following communication was sent in reply:

Your communication of the 25th ultimo to the Technical Society of the Pacific Coast, has, by a resolution of that Society, been referred to the writer for reply.

In compliance with this resolution and your request, I will name Mr. C. E. Grunsky, C. E., Flood Building, this City, as a representative and competent engineer to coöperate with your committee in the matter referred to in your communication.

[Signed] JOHN RICHARDS, *President.*

Mr. Marsden Manson, chief engineer of the State Harbor Commission, then read a paper entitled "The Circulation of the Atmosphere of Planets," which was discussed at length by Lieut. J. P. Finley, also by Chas. B. Hill and Professor Gale.

We much regret our inability to republish this paper, and the discussion thereon. It shows a great amount of original inquiry in a field of great scientific interest. A synopsis would be unintelligible to a reader and unfair to the author, but as an extra edition has been printed, copies of the paper may be had by addressing Marsden Manson, C. E., State Harbor Commission, 10 California Street, this City.

Mr. C. E. Grunsky presented a paper on the practical usefulness of irrigation engineering, and the necessity of providing means of acquiring and disseminating knowledge in this science, and suggesting the creation of a Chair of Irrigation Engineering in our Universities. This paper is reprinted in another place.

Mr. J. H. Hoadley, representing the Wheelock Engine Co., of Worcester, Mass., exhibited to the members an improved form of a steam engine valve, which he fully explained in its details and manner of manipulation, answering various questions and criticisms by interested parties. His remarks and the discussion thereon are given under another head.

The next regular meeting will be held at the Society's rooms on the 1st of July, at which time a paper will be presented by Mr. H. P. Frear, of the Union Iron Works, on the ordinates of a launching curve, or the path of a vessel when being launched; illustrated by diagrams taken from launching the steamship *Peru*, on the 11th of last month.

ELECTRICITY.

ELECTRIC GENERATING PLANTS.

IMPULSE ENGINES.

There is not in the whole range of constructive engineering a problem presenting so much diversity, not to say confusion, as electric generating plants. The enormous dynamos proposed by Mr. Ferranti, and the limit of 500 horse power, by others ; the triple expanding engine of the Corliss class, and the high speed single cylinder type, centralized and divided power, with a dozen more mechanical questions, seem farther from solution than any other important problem of the kind that can be referred to, and the strangest part of all is, that this diversity of practice is not due to undetermined electrical problems, but to what we call regular mechanical engineering. *The Engineering and Mining Journal* has recently commented on this matter, and our present purpose is to add to the matter a prediction that in the final settling down to a "type" the dynamo engine will not be a reciprocating one at all. If late reports published are reliable, there only remains at this time a lack of experience to confirm and develop these results to make the "steam turbine," or impulse engine, it may be called, the standard electric one.

If one will consider the amount of detail and bulk that is added to a dynamo engine by reciprocal motion, there appears a powerful incentive to adopt the direct or rotary type to that purpose ; but among the whole of the tribe of engines coming under the head of "rotary" there seems little hope or promise of success for dynamo driving, except the turbine. There has been a wonderful concentration of skill upon rotary, swash plate and other engines, not reciprocating, without a corresponding amount of success. The mechanical, or operative impediments are insuperable. It requires only a moment's time to point out the weak points of excessive strain, differential wear, excessive speed, faulty steam distribution, and other conditions in this class of engines that human skill is not likely to remove, but the impulse engine has only one impediment of principle thus far, which is low steam economy.

We may see some proof of this being the coming motor, or rather the motive part of dynamos, in the compact form and direct application of both single and double acting engines. Granting that maintenance is equal in the two cases, certainly the most perfect generating machine is one wherein the dynamo and engine are integral parts of one machine. The ideal dynamo is a steam one with intervention of the fewest possible parts between the boiler and the armature, and when these parts can with reasonable economy be reduced to a simple wheel, without metallic contact, there will be a strong tendency in that direction.

A period of evolution must be gone through as in all other inventions of the kind. No matter how obvious the final end may be, we imagine ten years must elapse before the real place of the steam turbine is known and it has reached its limitations. It is not yet four years since the first experiments of Mr. Parson were given out, and they appeared in a form to command much attention, because the results had been computed beforehand and realized as they were computed. The Dow engine, in this country, came still later, and in a mechanical aspect is a better engine than Parson's. It has a radial flow of the steam, the increasing diameter corresponding approximately to the desired expansion, thus dispensing with the nine wheels at first employed in the Parson engines, but the later designs, as we believe, have been much simplified, with an increasing economy, until experiments show results that may well claim earnest attention.

Substituting a little encased machine that one can pick up and carry, for a reciprocating engine that weighs tons, takes up ten times the room, and costs in proportion, is a revolutionary proposition in steam engineering, if a reasonable economy can be attained, and of this we have some assurance in the water wheel practice of this Coast. It is not many years ago when anyone proposing to employ the impulse, or spouting force of water on wheels, would have found themselves in the same position as they will at this time in claiming that steam can be used in the same manner.

A most wasteful application of the impulse method by "injectors" has not hindered them from finding a permanent place in modern uses, because of the simplicity of the apparatus and the completeness of adaptation to numerous purposes, and a less wasteful method applicable to a much wider range of purposes, forebodes a future of the steam turbine, especially as an integral part of dynamos.

ELECTRICITY ON COMMON RAILWAYS.

There is just now going on a good deal of talking and writing respecting the use of electric motors on standard railways, especially for urban traffic, and there are a good many reasons why the system is preferable to steam locomotives, but in most cases those writing and speaking of the matter call it electricity superseding steam power.

Any innovation of the kind will be sooner understood and adopted if people would stop talking of "electric motive power." An electric motor on a locomotive represents the boiler and engines, which we may say, are taken from the engine and placed in a station, from which the power is sent out to the engine through the motor. In this manner, it is a problem admitting of generalization to a great extent and does not "work out" at all, as is popularly imagined. For example, one hears that we will soon have electric locomotives, and the tons of dead weight now carried can be dispensed with. This is another mistake. The tons of dead weight is an essential part of a locomotive, performing an indispensable function, and if the steam power is removed, an equivalent weight of something else must be added.

There enters also into the problem a principle in mechanics which is sometimes called inter-dependence, and a very important one in this case. An automobile machine like a steam locomotive is independent within itself, and not dependent on other engines. The disablement of one engine extends no farther and need not disturb the traffic of a road beyond the train it is drawing, but if the power is centralized or distributed from a station, then the whole traffic of a line depends upon the maintenance of the generating plant.

A cable railway, or an electric one, compared with a steam or horse car route, illustrates the matter. When the cable or the current stops the whole traffic is suspended, but the traffic drawn by horses or steam goes on without liability to such detention. On the other hand we have the inefficiency of the horse system, the danger, smoke and heat of the steam one, so the final end, or "survival of the fittest," must be left to time and evolution, despite the prophecy of those who proclaim the substitution of steam with what they call "electrical power." Wholesale predictions of sweeping change, as said in the beginning, only discourage and hinder progress in the advancement of electrical methods that are now giving promise of wide application in what we call standard device.

THE MYSTERIES OF ELECTRICAL PHYSICS.

The late lecture and demonstrations berfore the Royal Society in London, by Mr. Telsa, has set us one step forward in the expected discovery of cörelation between heat, light and electricity, and the all pervading "ether," which is the medium or cause of all.

The part contributed by the lecturer was to furnish inferences from the phenomena of alternations in electric currents. The common dynamo produces about eighty alternations or reversals per second, but in the new Telsa machines the alternations have been raised to 1,000,000 or even more, with new and astounding results, and, as he remarked, the "experimenter entered a new region of mystery." It was discovered, for one thing, that while an ordinary current at 2,000 volts would destroy life, one at 50,000 volts caused no harm and could not be felt at all. The current could be passed through a sheet of vulcanized rubber, like light through a pane of glass, and of course insulation by the common methods is useless. One of the most important results that may follow such investigations, one that will alter the whole human economy, will, no doubt, be a source of dynamic force, unmeasurable and universal.

Pure speculation is not worthy of much attention, but when men like Sir William Thompson, Faraday, Maxwell, Crookes, and others set seriously at work to discover the occult causes that lie at the bottom of electrical phenomena, it may safely be assumed there is more than speculation to be dealt with, and that they are within some hopeful distance of discovering the natural source and relations of light, heat, electricity, magnetism, and with these, no doubt, the complete laws of motion and matter.

Mr. W. E. C. Gordon, in a recent article in the *Nineteenth Century*, says, on the subject of Molecular Physics :

"Professor Crookes has shown that the forces contained in this bombardment are immensely greater than any forces we have yet handled, many millions of horse power being contained in an ordinary room. Owing, however, to the forces being in every possible direction they neutralize each other, and no result of them is perceivable to our senses ; but if ever we discover how to so direct their courses as to send the majority of them in the same direction, we shall have at our disposal forces as much exceeding any we are now acquainted with, as the blow struck by a bullet exceeds the force required to pull the trigger of a gun. In fact, as Mr. Telsa put it in his lecture, 'We shall then hook our machinery on to the machinery of nature.' It is because they hold out to us a hope, however distant, of some day so guiding the ether storm, that the experiments of Nickola Telsa are of such transcendent interest and importance.

Professor Crookes, in his experiments on 'radiant matter,' has given us the first hint of a method of directing what, for want of more exact knowledge, we will call the molecules of matter. With the appliances at his command, however, he was unable to impart any great change of direction, but he succeeded in making that change manifest by reducing the disturbing forces acting against his directing force. In other words, he pumped out from glass bulbs and tubes nearly all the air or other gas that they contained, and the comparatively few particles left were then free to travel in any course imparted to them, without much change caused by collision with others. This special direction was imparted by means of electricity, and gave us the beautiful phenomena of phosphorescence and radiant matter, which are so well known in these experiments.

By means of suitably shaped terminals a stream of molecules is focused on a given point. If a piece of carbon or platinum is placed at that point it becomes white hot under the bombardment, from identically the same cause which causes a sheet of flame to appear when a cannon shot strikes an iron target. If a ruby, or other phosphorent material, is placed there it glows with its characteristic color, and if a little delicately balanced vane, or windmill, is placed on one side of its fans it rapidly revolves. The forces available in these experiments were, however, almost indefinately small, being, as it were, merely flying spray from the great torrent into which we have not yet been able to penetrate."

ELECTRICAL NOTES.

The three Siemens Brothers occupy a prominent place in the electrical industries of our day. One resides in St. Petersburg, Russia; one in Berlin; and one in London. In Berlin, Siemens & Halske is incomparably the greatest firm in Germany, and by some standards the leading one in the world. Siemens Brothers, of London, employ two thousand men, principally in the preparation of submarine cables and attendant apparatus. They own their own steamers for laying cables, and execute the greater part of European orders for this kind of work. The circumstances of this country do not favor the growth of such extensive individual industries, unless combinations are included under that head. Of the two a combination is, in many respects, preferable, even in so far as the effect upon smaller industries; also in having less of the "paternal idea," which is, or ought to be, repugnant to the people of this country.

The Westinghouse Electric Company, of Pittsburgh, has been awarded the contract for incandescent lights at the World's Fair in Chicago, and the Committee on Grounds and Buildings ask that a bond of $1,000,000 be furnished for faithful performance. It is not quite easy to see what this bond is for after the contract is let. The Westinghouse Company have a stronger incentive to honorable fulfillment of their contract than even a million of dollars represents, and there is something to be explained. The electrical operations at Chicago from the beginning have not been characterized by the good faith and open emulation that could have been desired, and this bond is no doubt, a kind of finessing operation.

Mr. Royal E. Ball, of New York, proposes in arc lamps, a flat, rectangular carbon in combination with a round one, the flat one arranged to vibrate edgewise as consumed, by means of a wave guide at the side. This should give an endurance to the flat carbon equal to its increased section, but it seems doubtful if this will repay for the added mechanism required, especially as the cylindrical carbon would be consumed more rapidly than in the common arrangement, and renewals would be required just the same, or even oftener. If moving surfaces are admissible, and increased section is desirable, one of the carbons could be made in the form of a cylinder and be given a rotary motion, which would be easier to produce than a pendulous or vibratory one.

"The Americans have been so largely occupied in developing the use of the alternating-current system of distribution that they have almost entirely overlooked the method of employing storage batteries in central electric light stations, or in conjunction with them in substations. Only two or three towns have made use of accumulators in this direction, but in this country, in Germany, France and Austria, these batteries are used to a large extent. We have, for instance, secondary batteries in use in the stations of the St. James and Pall Mall Company, the Chelsea Electric Light Company, and the Kensington and Knightsbridge Company in the Metropolis, and we believe also in a few provincial towns. In Germany storage batteries are utilized in the electricity works of Barmen, Hanover, Dusseldorf, Dessau, Berlin, Bamberg, Darmstadt, Bremen, Breslau, Stettin, etc ; in France, in those of Paris, Lyons, Toulon, Montpelier ; and in Vienna in Austria ; and Stockholm in Sweden. In most of these cases the secondary batteries serve the purposes of acting as regulators in the supply, of furnishing light in conjunction with the dynamos, and of supplying light solely when the demand is inconsiderable. There is, no doubt, that by the installation of accumulators in central or sub-stations a saving in working expenses is affected, since it is possible to shut down the generating plant when the lighting requirements diminish. It is for this reason, and for the general success of such combined plants, not surprising to find that attention is now being drawn to the subject in the United States with a view to the more extended use of storage batteries in that country." —*Mechanical World.*

Messrs. Easton & Anderson, a well-known firm of engineers, in England, have been constructing some electrically driven street cars by means of a worm-wheel, or screw on the armature spindle, meshing into a tangent wheel on the axle of the car, and as all the running parts admit of being completely enclosed, and are both cheap and simple, the method seems one that is very suitable for the purpose. From a drawing published, it seems the motors are supported in trunnions to permit the yielding of the axle in respect to the frame, and this too seems simple enough, but, of course, no gearing at all is preferable, if an economic motor can be made to run at the speed of the axles, as in the "Short" system. Of this there seems to be some doubt at this time, and as "tangent gearing" is durable when properly made, the scheme above is worth considering.

Mining Notes.

A scheme of some importance is now being carried out in the Couer d'Alene mines in Idaho. A tunnel is being made after the manner of the Sutro one at Virginia, to tap six different mines at a level of 2,000 feet from the surface, which is deeper than we supposed any of these mines had reached. The tunnel is the same size as the Sutro one, and will be, when completed, two miles long. There is always a chance in such tunneling schemes of finding ore veins that do not crop out, and this can be counted on as a margin if the established traffic will afford a revenue equal to interest on the investment in the tunnel.

The McArthur-Forrest process is summed up by the *Engineering and Mining Journal*, as a doubtful improvement on existing methods of extraction, except for certain ores and under certain circumstances, which is true of almost any process other than a "fake." The authority above named says of the McArthur-Forrest process, that "Ores containing arsenic and tellurium have proved obstinate to its charms, while those containing free fine gold, the so-called coated variety, and auriferous iron pyrites, have been successfully treated." The fascination of new discovery in gold-saving processes, renders all those interested in mining industry of that kind enthusiastic, and as all are expecting cheaper and simpler methods to arise, it is common to overestimate at first any new process. Then follows a reaction in which the whole thing is denounced, and then begins the real life of any process with permanent merit. It finds its way gradually into cases where it is suited, and finally becomes established. This will, no doubt, be the final history of the process under discussion.

The termination of the Hale & Norcross suit against the Nevada Milling Co. is a delicate theme to comment upon. There is not one in a hundred, among those who understand mining matters, that doubts the fraud practiced on the mine shareholders, so that comment becomes no more than "criticism of the courts," and the true query, one of justice or venality in law procedure. It now remains to be seen if the power of the courts is sufficient to, in any manner, make restitution of the money that is claimed to be taken. The *Mining and Scientific Press* advocates turning the mills over to the mines, which raises a problem, or rather two problems. The first, as to how the milling was ever separated from mines; and second, on what grounds was it ever assumed that the mill owners would "turn over the bullion" to the mines? This last query is a "poser" worthy of Lord Dundreary, and is something "no feller can find out."

In looking over fine concentrating of the day, one cannot help thinking there is some more "heroic" and cheaper way of selecting by gravity, than by means of slow moving agitated belts. The stratum of sand and water is so thin, that time for settling metallic particles seems scarcely required, and the room, investment, and even power consumed, seems all out of proportion to the results obtained. On the other hand, it may be said that there has been a concentration of skill on such machines, and that they have all assumed in the end, more or less the type of the batea, the progenitor of all. Perhaps the whole system has got into a "rut," with the batea for a "guide," and if so there is opportunity for radical change. Mr. Luther Wagoner, of this City, conducted some years ago a series of experiments, and laid down a formula for precipitation that should give some useful hints in concentration.

Local Notes.

The publishers of Industry were astonished by a proposition recently received from an engineering firm offering to pay advertising rates for a notice of some new machinery designed and made by the firm. It becomes necessary again to state that the reading columns of this Magazine are not for advertising purposes, and that no pay can be received for such matter; also that the publishers, in order to guard against an impression that such pay is taken, have always refused to insert, in the same issue, a notice of any new work or business, and an advertisement of the same. No explanation of this is required. Reading matter sold for a price injures the Journal and the business represented. Industry is not conducted that way.

The launch of a large ocean steamer at midnight is a romantic event. The glare of torches, and the roar of "wedging up," with the attendant confusion, spectators mixed and wandering in crowds about the vessel and yard, make up a memorable occasion. These were the circumstances at the launching of the Pacific Mail Steam Ship *Peru* on the 11th ultimo, at the Union Iron Works in this City. This vessel has been constructed in a remarkably short time, and as the Government work on the cruiser *Oregon* and coast defense vessel *Monterey*, and other government work, besides the dock and repair work, was carried on at the same time, and a force of 600 men on the *Peru*, it indicates something of the ship-building facilities at the Union Iron Works. The *Peru* is 345 feet long, 45 feet beam, 29 feet deep, and will have a gross tonnage of 8,800. The engines are triple expansion with cylinders 28, 41 and 70 inches diameter with stroke of 4 feet, capable of developing 2,800 horse power. This is the largest steamer that has been constructed on this Coast, and has presented no difficulties whatever, except that the ship filled the building-shed to within six inches of its sides. The Union Iron Works will have to extend their ship-building room, or sheds for construction. The other departments are crowded also, but these can be "doubled up" with less trouble than sheds and slips can be provided. The development of the business is phenomenal, and its commercial management, under the President, Mr. Henry T. Scott, has been as successful as the constructing departments.

The *Examiner*, of this City, maintains an office at Washington for soliciting patents, which means, no doubt, that cases sent there are farmed out on a commission, because any fair fees exacted would fall far short of employing any one competent to attend to that business at Washington. This is not however the principal query respecting a patent soliciting business so conducted, for clients on this coast at least. It is commonly difficult enough after conference with an inventor, and in most cases an examination of his improvement in use, or practically applied, to frame a proper specification, and how such a thing can be done by letter, is the query we present? It is seldom that applicants on this coast risk having their cases prepared even by well known and responsible firms at Washington, and we think the *Examiner's* Pacific Coast clientage must be confined to a class of inventions not requiring much skilled understanding, but these are, perhaps, the kind preferred. If any of our readers have a specification on some technical subject, prepared at the Examiner Bureau, it will be a favor if they will send it for examination.

Mr. Arthur McEwen, writing in the *Virginia Chronicle*, on the 7th of last month, hit upon a truth of such value that it deserves reproduction here and elsewhere. He calls attention to the fact that San Francisco is a "sea-port city," and whatever of natural advantage there is here relates to ocean commerce. He says not one new overland railway, nor a dozen of them, can have much effect on the interests of the City. This is our contention and belief. There is already an ample railway service to the East, capable of carrying all there is to carry, and how more roads are to better the matter is hard to see. As to competition, that is not worth discussing. There are no means of maintaining competition, except so long as it "pays." What we want is ocean commerce. If this condition is left out, San Francisco has no more claim upon commerce than any inland city. With it she is supreme. While criticising, we will also mention the common opinion respecting an increase of population on this Coast to consume products. How is an added population to consume surplus products, when the only people that will increase business and wealth are themselves producers? The Coast is filling up quite fast enough, except with agriculturists, or those who send their products out of the country. What is wanted here is ocean commerce, not more trans-continental railways or more people, until there is something profitable for them to do.

The American Society of Civil Engineers has requested the Technical Society of the Pacific Coast to appoint a member of that body to confer with a committee of the Civil Engineers Association respecting the presentation of technical papers to be read at their meeting in Chicago next year. Mr. C. E. Grunsky, of this City, has been appointed from the Technical Society for that purpose, and it is trusted will succeed in sending, from this Coast, a number of papers that will be highly creditable. There is, perhaps, no other field, or section of the country, that affords better material both as to subjects and people to treat them. Among professions here it it may be said, without disparagement to others, that the civil engineers are famously represented. Their works are bold, extensive, and developed under circumstances that have called out much novelty in both procedure and results.

Mrs. J. C. Winans, of San Mateo, has painted a number of large pictures that have consumed years of effort, and is yet pursuing the work after quite a large gallery is filled. The circumstance is in itself remarkable, how remarkable we will not assume to say, because not acquainted with the technique of art, but it is illustrative of the natural gift and power of delineation. The conception and execution of this work is evidently not a matter of training and execution alone, or even mainly, but is due to those same causes that, under like circumstances, make eminent men and women amidst a field of mediocrity. These paintings are shown to those who will visit the gallery by appointment, and are well worth a trip to see and study. They should come to the City.

The Traffic Association, which has occupied a good deal of attention for some months past, and might have done an important work, has drifted from the newspapers, where the operations began, into "politics," and that will possibly be an end of the matter. Had the association worked with closed doors, and kept their council to themselves, they would have been a power in the commercial affairs of this City long ago, but there is too much "person" and too little "public" for that course. They might have drawn a hint from the "Foundrymen's Association" of this City. So long as the moulder's strike was dealt with in the newspapers nothing was accomplished, but when a quiet organization, the membership of which was not known, or even the place of meeting and the objects of the organization; the strike was soon settled and ended. The railway interest with its able and organized methods, is not likely to pay much attention to newspaper movements.

The California Wire Works in this City has a large plant at North Beach, where there is carried on an extensive manufacture of wire and wire products. A cable recently made for one of the City lines, five and a half miles long, was prepared in 52 hours. It weighed 37 tons and required 60 horses to haul it from the works to the power house. The total weight hauled was about 55 tons, or a little less than one ton for each horse. Mr. A. S. Halliday, the president of the company, was the original inventor of the cable railway system, and has studied all the circumstances connected with cable making, as well as the operation and financial problems involved in this method of propulsion. It was a bold idea in its first inception and the "evolution" of it has not called for changes from the first plans so radical or extensive as is common in the case of new and extensive inventions. A cable road of our day is not different in its essential features from the old Clay Street one.

In a communication from the Hon. Commissioner of Patents, addressed to the Editor of INDUSTRY, there are the following remarks.

"My attention is called to your remarks in the June number of INDUSTRY, beginning on page 523, concerning models of machinery which we shall use in the Patent Office Exhibit at the World's Columbian Exposition at Chicago. I am pleased to be able to say that you have taken an entirely mistaken view about the nature of the models we shall send. Our exhibit will exceed in completeness and value any similar collection ever got together. It is now expected to comprise about three thousand specimens, most of them of excellent workmanship and finish. I hope for the sake of the exhibit, that this matter may be corrected in your next issue."

We are glad to correct any wrong impression conveyed by the remarks in our June number, above referred to. One in dealing with constructing engineering of our day, is apt to acquire a poor opinion of models, and connect them with a time when movements and relations had to be practically demonstrated to be understood. The extent of the display indicated, is astonishing, and it will no doubt be as the Commissioner of Patents claims, a feature of great interest at the exhibition.

One of the most ingenious and useful small things met with for some time is what is called a "finger spade" to be used for gardening purposes, an implement with a socket to fit on the forefinger, and provided with a small spade, it may be called, at the end. The implement can be worn with a glove, or without, and not only protects the fingers from dirt and injury, but permits all kinds of operations in weeding, and otherwise treating plants, that cannot be performed with the bare fingers. The inventor, Mr. Thomas W. Breen, of Sausalito, Marin County, Cal., is a gardener, and hit upon this useful expedient to facilitate his own work. To meet a demand from others who have seen the "weeding thimble" he has begun its regular manufacture.

Messrs. Cahill and Hall, makers of the hydro-steam system of elevators in this City, have been making a boring machine to prepare hydraulic cylinders, that is a good example of special machine tool practice. The machine is 25 feet long, mounted on a massive sole plate 21 × 5 feet weighing alone 19,200 pounds. The bars are 10 and 14 inches in diameter, mounted in sliding heads and have a variable feed by means of change of gearing. The maximum "cuts" made this far are in bores of 22 inches diameter, ⅜ inch cut out, with a feed of ⅛ inch for first cut, and ⅜ to ½ inch for finishing cuts. This machine confirms some views set forth in this Journal last year respecting boring, wherein it was contended that a sole plate with simple bar supports, fitted for lineal adjustment and simple gearing to drive the bar was all that was wanted. The machine above referred to, which seems to have all the functions required in general work, has less than half the parts that regular machine-tool makers commonly think necessary.

The burning of the Fulton Iron Works, and the car works of John Hammond, on the 29th of May, was a commercial loss to this City not to be measured by dollars and cents. The Fulton Iron Works, third in rank here among our engineering works, was especially identified with local industry and conducted in a manner to command the respect and regard of all others engaged in a like business—was the boldest of all in the way of a diversified practice that included everything from a mining bucket to a steamship. It is scarcely five years since both the Fulton Iron Works and the Hammond car works were burned before, and it is improbable that they will be built again with such dangerous surroundings, and where room is so restricted. The loss in such cases is understood only by people engaged in similar business. Patterns, drawings, collected data and references, special implements and the like, cannot be bought to replace what is lost, and then there is the further and greater loss of disorganization.

Just at closing the forms of this number comes confirmation of the death of Andrew Fraser, mining and mechanical engineer, of this City—a great noble-hearted man in the prime of life, a friend of all who knew him, distinguished in his profession and in all connections. He was foully murdered, supposedly by a native guide, between Chihuahua and some mines, 200 miles inland, in Sonora, Mexico; when traveling on business for the Risdon Iron Works, of this City, where he has been connected for several years past. His relations with the Company and its officers were such as make his loss like one of a family. He was 54 years old, a member of the Technical Society of the Pacific Coast, and will be mourned by a wide circle of friends, here and elsewhere.

COMMENTS.

The terrible circumstance of flood and fire in the upper Allegheny Valley, at Oil City and Titusville, Pa., is but an extreme penalty of encroachment on water lines. The tributaries of the Ohio, and that river itself, are subject to enormous floods. Halfway between Pittsburgh and Cairo the high water reaches about 65 feet. All tributaries rise in proportion from 10 to 40 feet, the Allegheny still more, and as there is no law or regulation to prevent encroachment on these levels, the water no more than subsides until people begin to press back again within the danger line. The incentive is strong. It is provoking to see lying between one and normal water levels, acres of land worth thousands, or even hundreds of thousands, of dollars, which is not submerged oftener than once in three years, lie idle and unoccupied. The danger is forgotten in this desire of gain, and people press forward to be again and again drowned out with loss of life and property. It seems a proper function of the law to prescribe lines beyond which people shall not build or maintain structures or business to endanger life; in fact, it is a special duty of the law to guard people against danger in cases of the kind.

Messrs. Carnagie, Phipps & Co., of Homestead, Pa., are no doubt strong supporters of customs taxes, or tariff on imported implements, but find it to their interest to buy tools abroad to be employed in making work for the Government. A foreign journal says this firm has recently procured in Germany a circular cold saw 90 inches in diameter, to cut armor plates. This machine was no doubt imported free of duty, on the principle suggested by the U. S. Gun Commission some years ago, who recommended that Whitworth tools for making guns be brought from England, because "the Government could import the work free of duty." There is certainly nothing about a cold saw of any kind that would strain the capacity of our own machine-tool makers. This is not the first nor even the second time the Carnagie firm have purchased implements abroad, but then their doctrine of protection is for the "other fellow."

A number of our contemporaries are extracting happiness from a report that certain Welsh firms, among them Messrs. Morewood & Co., intend erecting tin-plate works in this country. There is no doubt of it, if the present premium or tax of 75 per cent. continues to be levied on the product. The Welsh will, no doubt, build such works here, and proceed to buy out those now built, by American owners, so we will have the advantage of being employed in an almost unskilled industry, and the profits of the business sent to England. Those patriotic people who hastened to import all the tin plates in Wales, previous to the assessment of the present duty, would feel no reluctance in selling their works to any foreign buyer that offered. The doctrine of self-interest is the crowning vice of our day. The man who stands out for principle is becoming obsolete, and when one reads of the spirit that actuated those who built up the country at the beginning, and endured the sufferings at Valley Forge, it sounds like tales of the Arabian Knights.

The Chief Commissioner of Railways in New South Wales, Australia, in a recent address at the Railway Institute, in Sydney, gave credit to American locomotives, that to say the least, was not comfortable for English makers. The Commissioner had ready a long array of facts and quantities not set out in mathematical precision, consequently will be called in question, as all statements of the kind may be, but will be hard to controvert. The engines referred to were made at the Baldwin works in Philadelphia, and so far as can be seen were typical American locomotives, down to the much derided "cowcatcher," which is, no doubt, an useful appendage in Australia. Mr. Eddy, an engineer who was present, supplemented the Commissioner's remarks with a number of additional facts in favor of American engines, and also "bogie cars," to carry 22 tons of goods, which have recently been introduced on the South Australian lines.

The Builders' Exchange, in Pittsburgh, are imbued with the idea of monopoly, and have carried their doctrine into practical effect by disputing the right of any one to build houses in that city, except members of their association. To carry this principle into effect, they refuse to sell material to outsiders, and otherwise prevent them from executing contracts. In so far as the Builders' Exchange, this seems a very efficient means of increasing their earnings, but the other part of the community, who are not members of that guild, and who pay the taxes and foot the contractors' bills, will no doubt have some opinion in the matter, or ought to have, considering they number about a thousand to one. When people become imbued with an idea of unequal rights, there seems no limit to their demands and exactions.

In the last annual report of the North Dakota Railroad and Grain Warehouse Commission, there appears the following paragraph:

"In nearly all cases where the Commissioners have, after careful consideration and investigation, made a request or a demand that a wrong be righted, the railway companies have been prompt to acknowledge their error and right the wrong. We think that railroads are useful and necessary institutions; they are agencies of the state, it is true, but the state would not be benefited by striking them down or crippling them so as to prevent their accomplishing the ends for which they are constructed. The power to regulate should not be construed into power to destroy, and as railroads are necessary factors in the building up of great states, we would recommend that a moderate course be pursued toward them, and that more railroads be invited to invade our broad domain, for competition will do more to reduce freight and passenger rates than legislative enactment."

The *Railway Review*, from which the above is taken, says, in comment:

"It is evident that these gentlemen comprising the board of commissioners, have the best interests of their state at heart, and propose to do all within their power to foster them, regardless of the demands of both unreasoning and unreasonable men, who would from ignorance or design limit their usefulness."

The *Ohio Valley Manufacturer* says a tariff, when once made, should not be disturbed for ten years, and thereby would destroy one of the main objects of the tariff, which is the speculation which changes in prices permit. In ten years a tax distributes itself over various commodities in so far as internal trade, and its effect is less felt, but in that way, how are the favored industries to reap any benefit? The importation of tin plates last year is an example. The patriotic people who wanted to promote this industry in the United States, bought all the tin plate they could find in foreign markets, and hurried it into the country before the high rate of duty was imposed. The same thing is true in other cases, and it is the sudden disturbance of prices that makes the harvest for those who are prepared, as Ben Butler was with his bunting factory. Our contemporary is wrong. The tariff, to serve the objects or its beneficiaries, should be altered just as often as prices become stationary.

In late numbers of *Engineering*, London, there has been a continued illustrated article called "A Short History of Bridges." The subject is extremely interesting, but it must be questioned whether it is on the whole creditable to an art that should long ago have taken on some uniformity. In so far as iron and steel have been introduced as material for bridges, during forty years past, it is natural to look for changes and modification, such as would arise in such cases, but when we consider that wood and stone bridges have been built ever since civilization began, and the theories of static forces is more than 2,000 years old, it becomes a question whether the wonderful diversity of bridge design is creditable to civil engineers.

The economic distribution of material, as well as some of the destroying forces and conditions of endurance, have been the subject of comparatively recent discovery, but why ten or twenty bridges of like span, and for the same purpose, should be made to the same number of different designs, is not quite clear to a constructing engineer of our day. It is probable that a great share of the diversity in bridge design comes from a desire on the part of civil engineers to create something distinct each time a new bridge is laid down. There is also a doubt as to whether civil engineers are as fertile in the contriving faculty as their mechanical brethren. We are speaking now of the sense in which these terms of civil and mechanical engineering are applied in this country.

Industrial Notes.

There is a feature of English drilling machines that we think deserves attention here among the makers of such tools. We mean tapping attachments for driving screw taps. A good share of English machines are made with a ready slow motion and a clutch for reversing the spindle, so that holes to be tapped are finished before taken from the drilling machine. There are several kinds of devices for the purpose, and while the method is of no use whatever in regular manufacturing processes, it is very convenient in jobbing and irregular work. Not only does tapping on drilling machines save time; it secures true work. It is very seldom that a hole is tapped true by hand, and if made true, there must be setting, trying and adjustment that consumes time.

The *Railway Review* mentions the use in France of a "grade indicator," that is mounted on locomotives and shows at all times the grade of the road over which the engine is passing. This is concrete common sense, and as the indicator is no more than a double leg glass tube filled with liquid and provided with a scale for the slope, we think the sooner it is applied to all engines the better. If such an instrument was fixed in a cab, the engineer might not only derive useful assistance from it in running, but would in a few trips learn the profile of a road, that would by other means require a long time and be uncertain in comparison. The gauge above mentioned is 15 feet long with vertical legs at each end, but such a length is certainly not necessary. One four feet long, or a curved one, would answer the same purpose. A common level acting on the same principle is only 24 to 28 inches long, and an accurate level much less, a suspended weight. or pendulum, might answer the same purpose, but would be subject to vibration.

This is a day of tests. Our exchanges come burthened with tests of compound, triple and quadruple engines; tests of boilers, ships, mills; tests of everything—tabulated, arranged and set forth in all the minuteness of precision. Taking engine tests alone, it is safe to assume that technical journals and technical literature generally, is twenty per cent. tests. The matter is overdone, and tests by reason of their redundancy are becoming like paid expert testimony, good for what they are worth. Observed phenomena of whatever kind has value, but when connected with commercial objects, as most reported tests are at this day, they are not worth very much. They are expensive when conducted in a proper manner to determine scientific results, and require for that reason a heavy "donation" from some source. It is not long ago when the trial of a steam engine was an event of importance, and one of confidence. Now it is neither, however fortified with diagrams and formulæ, because the "margins" are narrow and the attendant circumstances so varied.

There is often discussion in mechanical journals respecting the "height of cutting tools," and it would be a comfort if some one would explain what is meant by the term. The angles of edges applied in turning must be. expressed in respect to a tangent of the surface, the axis of rotation, or the shank or stem of the tool, otherwise there is no meaning in the phrase. In common shop parlance, "height" in such a case means above and below an imaginary level plane through the axis of the piece being turned ; but even this means nothing unless qualified by the angle of the tool faces. The only constant thing in the case is the angle of the inner tool face in respect to a tangent, and if terms to indicate this were employed, one could gather some meaning from the discussions, but not otherwise. Height means nothing, because a tool when set with reference to a piece can be revolved around it without any change of the relative positions of the tool and the work.

"The *Railway Review* of May 21st, gives the following particulars of the work at Niagara Falls :

"It is stated that there are now engaged to work on the Niagara tunnel over 400 men, while on the surface 100 more are employed. The men work in 12-hour shifts, and the work is carried on both day and night. It is stated that a Canadian power company has secured the right to develop a water power on the Canadian side of the fall. The company is practically the same as the one which is at present carrying on the work on the American side, and it is proposed to use the same system as is there employed. It is further stated that the rental for the first ten years is to be $25,000 per year ; for the second ten years it is to increase $1,000 each year until the end of the twentieth year, when it reaches $35,000, at which rate it is to be continued. The company undertakes to begin the work on or about May 1, 1897, and will have proceeded so far with it by November, 1898, that it will have completed water connections for developing 25,000 horse power, and have actually ready for use and transmission 10,000 horse power. The capital stock is not to exceed $5,000,000.

Miscellaneous.

The New York Central and Hudson River Railway has the distinction of operating the fastest train known at this day, and all the more remarkable because this country has not, for several reasons, found it expedient to move railway trains at the highest speed. The train referred to is between New York and Buffalo, 439.6 miles, which distance is run in 8 hours and 40 minutes. The train has been in service since October last, and will, no doubt, be permanently maintained. The weight of the train is 230 tons, consisting of an engine and four carriages. The incentive for maintaining a train at this speed is competition, and while the expediency of running at this high speed may be a question, there is no question respecting 20 miles an hour on the California roads. It is too slow, and tolerated only because people cannot help the matter.

One of the Princes in India is giving his Caucasian brethren a lesson in railway luxury by ordering, in England, three cars to cost $50,000. The length is 63 feet, 10 feet 4 inches "beam," and for a gauge of 5 feet 6 inches. The roofs are double to avoid heat. These carriages are electrically lighted, have baths and all possible conveniences. The outside, says an exchange, is to be finished in "cream and gold." For use here by our millionaires these cars would not be especially luxurious, but in India, where our methods are not supposed to be imitated, the case is different. The Indian princes yet wield great authority in India, corresponding to our states under the Federal Constitution in some cases, in others with more nominal sway.

The Brown Hoisting and Conveying Company, of Cleveland, Ohio, have built a coal-storing shed at Buffalo, New York, for the Reading Railway Company, that has a roof 672 feet long, 354 feet wide, and covers 5½ acres. A writer in Cleveland contrasts this with the roof over St. Pancreas station in London, which is 690 feet long and 245 feet wide, but there is no comparison in the case. The St. Pancreas roof is one span without central support, while the one at Buffalo, being for a coal-storing shed, has numerous supports, and might just as well cover 10 or 20 acres as 5½. Enormous roofs of one span are seldom, if ever, necessary, and are commonly constructed for architectural display. Plans for a single span roof were prepared for the Sutro Baths at the Cliff House, but Mr. Sutro has wisely concluded to avoid the risks of such a structure.

LITERATURE.

Transactions of the American Institute of Electrical Engineers.

Vol. VIII, 1891.

We are favored with the above named report of 635 pages, well printed and bound, constituting a valuable addition to the electrical literature of the day.

The society contains 578 members, of which 408 are associates, 172 full members, and three honorary members. The disbursements for the year ending May 19th, 1891, were $5,213.77.

One general feature of the report that will commend it, and also offer a useful suggestion, is the copious discussions that followed the reading of papers at the regular meetings of the Institute. These discussions are well distributed, and in most cases indicate perfect familiarity on the part of the speakers with the subjects treated. In some cases, as in the discussion over the name of the metal aluminium, there is indication ot verbosity, but generally remarks were able and candid, indicating an unusual degree of qualification among the membership.

A fine portrait of the president, Prof. Elihu Thomson, forms a frontispiece, and will be a surprise to most people, indicating, as it does, a man very young in years for the extensive part he has borne in modern electrical development in this country.

Mr. O. F. Crosby, superintendent of the Sprague Electric Railway Motor Co., presented a lengthy paper on the Weems, Baltimore Electric Railway, which half a year ago was described and discussed in various journals over the country. The paper contained a good deal more computation and inferential results than facts, and on the ground of utility, cannot claim a very high place in the list. The transit of people and merchandise is rapid enough now, or might be, if common railways were operated at speeds as great as is safe and possible under the present system. The papers throughout, as well as the discussions, indicate great energy and interest in research, and the society is likely to endure and increase.

Consular Reports.

DEPARTMENT OF STATE, WASHINGTON.

Nos. 133 and 134 of these reports are at hand, and the first thought in respect to these documents is the wasted effort they represent. No country in the world has taken more pains to place before its people the facts collected by their consular service, and perhaps no country is less benefitted by the information thus provided, because it is not read.

For example, in Report No. 133 for October, 1891, Mr. Julius Goldschmidt, Consul General at Vienna, Austria, contributes a paper on "Grain Crops of the World," showing the amount of wheat, rye, barley and oats produced and exported in all the principal countries of the world. Aside from the interest that the matter should have to those engaged in wheat growing in this country, there is the farther importance of the commercial advantage that might result from understanding the facts given.

In Report No. 134 for November of last year, there is a significant report by Consul General Edwards of Berlin, Germany, on the prices of food products in the empire, which may be profitably studied in connection with the present social disturbance among the German people. The enhancement of prices due to the tariff system has required a number of years to reach the food supply, but its final distribution over all prices was sure to follow, a fact that Germany is now in position to attest.

From August, 1887, to August, 1891, four years, the price of rye rose 91 per cent. During last year alone, the increment of prices for wheat, rye, barley and oats, has been about 25 per cent. Butter, beef, bacon and lard rose in price about 5 per cent. Germany's trade has fallen off greatly during some years past. To the South and Central American countries the exports of last year were half as much as in 1889.

The trade and finances of the Argentine Republic make up 69 out of 211 pages in Report No. 138, for March, 1892.

Consul E. L. Baker, in this showing of affairs in Argentina, has a dolorous task, especially in dealing with the disordered finances of the republic, and in his terminology sticks to the myth of "value for gold." The gold dollar, as he states it, ran up in value from 122 in 1885, to 322, and even 372, and at one time in 1891, the premium reached 450; or to be more exact, the paper currency ran down that much in value. It would be just as reasonable, or even more so, to gauge the value of gold from the price of iron, which no one ever does, as to estimate it from a paper currency. Gold has all the time the same value, or if it change at all, in relation to other commodities, does so only throughout long periods, and so slowly as not to be discernable in business; but this is by no means an important point in the voluminous statement Consul Baker has furnished.

The account is the most authentic that can be referred to respecting one of the most remarkable bubbles of modern times, conducted or promoted by conservative bankers, or those considered conservative, like Baring Brothers. Consul Baker says of the speculative period:

"Thousands of companies for hundreds of different undertakings were organized and floated with millions of capital on paper, only the first two or three installments of the stock generally being required in cash, with subscribers' notes for the balance, each one being guaranteed beyond the possibility of a doubt to pay the fortunate holders the most fabulous sums of profit and gain. The United States, where the rate of interest on capital is, on an average, two per cent. better than it is on the other continent, incredulously stood aloof from all these tempting offers, quite satisfied with smaller but surer profits nearer home; but Great Britain, France, Germany and Belgium "rushed in" to the tune of hundreds of millions of pounds sterling. Now that the balloon has collapsed, now that the flaming rocket has burned out and come down a stick, they find that in too many cases they have little left to show for their money, except uncounted piles of worthless or discredited bonds and stock certificates."

The Consul intimates that now is the time for investment in lands and real estate in the Argentine States, especially in Buenos Ayres, and he is certainly correct. Anyone with money to invest can do no better than to purchase property in the city of Buenos Ayres, where bargains can be had at 33 per cent. on values that certainly should come about in five years or less time. There is only to be dreaded the imposition of tariff taxes that will stifle and destroy the trade of the country. It is a desperate means of raising revenue resorted to by most of the Spanish-American countries, with results that need no comment here.

Cassier's Magazine—April, 1892.

This magazine comes this month with its usual complement of original essays on various technical subjects, and in addition a short biography of Prof. John E. Sweet, accompanied by a fine likeness of him. The subject matter will be new, even to those who are familiar with Prof. Sweet's life since his appointment as a teacher at Cornell University in 1873. We say it will be new, but no surprise, because anyone who had read his "Mechanical Refinements," in *Engineering*, during 1871–2—or indeed any of his writings on technical subjects, could easily discern that his education had been wider than a college, or a works even, and had been spread over a broad field of human activity.

His methods of writing, teaching and constructing are unique and extremely practical; an anomaly, as we may say, because here is joined two qualities that are in a common sense antagonistic. His teaching, which admits of separate qualification, was unqiue, because intensely practical. "Sweet's boys," are known all over the land, and do not need farther recommendation to find employment in almost any works.

His methods have met with the criticism of not being scholastic, to which the answer is, he was not compelled to make his methods scholastic. He taught in manner and nature, what others could not, because he had a wider experience in various branches of skilled industry—an experience in construction, gathered in different places and in different branches, qualified by a devotion and self-denial that few are capable of.

One part of Prof. Sweet's life is not included in the brief biography given—that considerable part devoted in kindness, and without hope of reward, to his fellow men. This measure is full, and when his store of vitality is "overdrawn," as it often has been, the debit belongs in main part among his friends, and there is to him a copious credit in that book the angels exhibited to Abou Ben Adam.

The Diseases of Almond Trees.

We have received from Newton B. Pierce, Esq., a copy of his essay on the above subject, reprint ed by the U. S. Department of Agriculture, and can only say that the investigations made are submitted in a concise and compendious form that shows a desire to benefit this industry in fruit growing, which seems to be the most uncertain crop of all here in California.

The division of "Vegetable Pathology," from which the present paper emanates, has coined a new but relevant name. The analogy to human or animal pathology is complete, if we concede the parasitical theory of disease. Suggestions for treatment of *cercospora*, the technical name for the almond tree spots, is appended by Mr. B. F. Galloway, recommending a spray solution consisting of five ounces of copper carbonate, three pints of aqua ammonia, with 45 gallons of water. All literature on this subject from careful investigations is of great value on this Coast.

Catalogue of the Thompson-Houston Co.

MINING DEPARTMENT.

This extensive and complete catalogue of more than 200 pages, 8 × 11 inches, we notice among technical literature because, aside from its main purpose as a trade circular, it contains the most advanced information respecting machines and apparatus for employing electricity in mining operations. The art, to so call it, is new, and the present is by far the most systematic attempt to produce a class of motors and connections for haulage, hoisting, pumping, drilling, and so on.

It amazes one to consider the possibilities of electrical transmission in mining operations. The circumstances are peculiarly favorable to this method, of both the distribution and application of power, especially if reciprocating movement can be produced with solenoids, as seems to have been successful in cases reported of operating rock drilling machines. There is, however, a wide and intricate field to be gone over. Schemes will rise and schemes will fall, but there is much to commend in the bold attempt here made to lay down in drawings and descriptive matter, methods for nearly all the power operations in the mining industry.

Aerial Navigation.

BY O. CHANUTE, C. E.

The *Railway and Engineering Journal* republishes in pamphlet form the lectures of Mr. O. Chanute, delivered before the Sibley College, Cornell University, in 1890. The lecture is of a kind most unexpected from an engineer like Mr. Chanute, who has been president of the American Society of Civil Engineers, not that he has not performed a useful duty in a very complete manner, but how he could tolerate and digest the "rubbish" to be dealt with is a wonder. The lecture, as here presented, is an epitome of the whole subject with scant comment, such as one would look for.

We have noticed in this Journal most of the events worthy of note in this flying art, and must, after going over Mr. Chanute's lecture, reiterate our opinion, many times expressed, that the matter is "bosh." Sustension and propulsion in a gas is quite unnecessary, so long as we have the earth to run upon, and out of the whole presentation we can see but little worthy of study, or presenting hope of successful travelling or carrying in the atmosphere, even if that were desirable.

One effect of Mr. Chanute's lecture will be to deter educated people from wasting their time in mechanical contrivances for flying by pointing out the laws or dynamic conditions of sustaining and propelling bodies in the air. For this class of people the subject is now, as we may say, nearly at rest, except in so far as aeroplanes, which seem to involve some features not understood or explainable. The present essay can be procured from the *Railroad and Engineering Journal*, or from the author at Chicago.

The Californian Magazine.

JUNE, 1892.

Last month it was our privilege to find fault with Mr. Benjamin F. Butler's article in the *North American Review* on the Behring Sea problem, and we think those who read the essay of Mr. Cantwell on the same subject in *The Californian* for June, will agree with the criticism in our review of Mr. Butler's article.

Mr. Cantwell is dignified, orderly and exact, and moreover, has found language of singular perspecuity in which to set forth his views. We have no space for a synopsis, and can only refer our readers to the original matter, and at the same time to a contribution of unusual strength, by Mr. C. F. Hopkins, under the title of "Shall We Educate Our Politicians?" We say this article should be read at the same time, and also the one above referred to in the *North American Review*, because at the end of such reading one can very well understand the importance of "educating politicians."

B. F. Butler's method and manner of treating the Behring Sea matter is political and "unlearned;" Mr. Cantwell's, on the contrary, is not political, but learned. Without wanting to be provincial or prejudiced, as people sometimes are on this Coast, we must claim for *The Californian* a first place in its descriptive and illustrated sections, and something more for its essays. Mr. Hopkins' article, for example, is in his usual style incisive and fearless, so has been most of the writings in the magazine on controverted subjects. People are apt to respect the truth, however it may grate upon their interests or preconcerted views.

The article on Thorwaldsen is admirable, and open only to the criticism of not more forcibly pointing out the most remarkable feature in the great artist's work—the amount of it. It has been our privilege to visit the museum in Copenhagen, and the principal wonder was how all the work there was crowded into one life.

The note on page 32, respecting the letter W, is confusing. We do not understand how "double V," or our "W," can be employed in the "middle" of a Scandinavian word or name. Double V and single V, are, as we understand it, the same in Scandinavian, except as employed at the beginning or "within" a word.

Report of Chief Constructor U. S. Navy.

The report of Chief Constructor T. D. Wilson, for last year, is a routine one, exhibiting the new and repair work of the preceding year. In respect to wooden vessels, the Chief Constructor says:

"The wooden steam vessels of the navy are rapidly disappearing from the active list of the service, some being condemned, some having been sold, while others are being utilized as training and receiving ships, and still others are laid up in ordinary, having exceeded the 20 per cent. limit allowed for the repairs of such vessels. Only twelve are now available for cruising purposes, and they, within five or six years, will be mustered out of service, as their repairs exceed the limitary amount fixed for that purpose"

Contracts made with the Bethlehem Iron Company for armor plates, previous to June of last year, were 5,310 tons; with Carnagie, Phipps & Co., 6,043 tons, and 4,735 tons not then contracted for; the total required for ships under construction was 15,945 tons.

There is the usual extensive and urgent demand for machine tools in the navy yards, a demand that is not always measurable by real wants. As a rule, the equipments of tools is irregular. A part is good and a part bad, and in every yard there is continual complaint of tools. The methods of selection are such that these equipments never can be good. The machines are picked up here and there, of diverse quality and heterogeneous design.

There is strong recommendation of apparatus for testing the resistance of ships by means of models, propelled in tanks, a method that has met with much approval by eminent private shipbuilding firms, but one would think, considering the uncertainty of such experiments, that computations were more reliable. Mr. Dickie, of the Union Iron Works, says "Nothing is more uncertain than figures, except facts," and there is a good deal to support the proposition in engineering work. Everyone knows that a "fact" in the common sense of that term, is not evidence, and worthless, unless the result of careful and scientific experiment.

Safety Valves.

BY BARNET LE VAN.

It is a little discouraging to a mechanical engineer, and especially to a student or an apprentice, to find a book of 150 pages written on "Safety Valves" alone, a detail which is commonly regarded as a simple one in steam apparatus, but it will be found that Mr. Le Van's treatise is not padded or strained, and contains only such information as should be possessed by anyone designing or dealing with safety valves.

In their functions such valves become a very important part of steam machinery, and their neglect a frequent cause of destructive explosion. It may also be said they are by no means as simple as at first appears, and as will be concluded by anyone who examines the present work and the multifarious designs that have been proposed and used.

Among a great many rules given for the area of safety valves the greater part of them are founded on grate area; for example, the Franklin Institute formula:

$$A = \frac{G\ 22.5}{p + 8.62}$$

where G represents grate area in feet and p steam pressure above the atmosphere. The English rule is to divide the grate area in feet by 2 for inches of area in the safety valve. The United States rule is to divide the heating surface in feet by 25 for the valve area in inches.

The book is sent by Messrs. Osborn & Alexander, of this City, is bound in a convenient form and costs $2.00, which can well be invested for a single valve design.

Valve Gears for Steam Engines.

BY CECIL H. PEABODY.

This new treatise we are much inclined to set down at once as being in method and arrangement superior to any work on valve gearing that has preceded it. The author says of it;

"This book is intended to give engineering students instruction in the theory and practice of designing valve gears for steam engines. With the vast number of valves and gears in use at the present time, an exhaustive treatment in a text-book appears out of place; the author's aim is rather to give the learner a firm grasp of the principles and some facility in their application. Each type discussed is illustrated by one or more examples selected from good practice."

Mr. Peabody is Associate Professor of Steam Engineering in the Massachusetts Institute of Technology, and has arranged his work not only with respect to and embodying other literature on the subject of common valve gearing, but also with the purpose of providing a text-book in the Institute with which he is connected.

One thing much to be commended is the confinement of the subject matter to the field of common practice, and absence of intricate and exceptional gearing, or to state the same thing in a different form, there is an absence of pedantry so common in the writings of those engaged in instruction.

The author employs the Zeuner diagram to illustrate valve movements, and properly too, because it is best understood, and has advantages in graphical or experimental application not possessed by other methods in the same degree.

The author can be congratulated on an unusual happy power of description, without quantities, that is, in conveying general, as distinguished from specific information. For example, he says in respect to radial valve gearing:

"The name radial valve gear has been applied to a number of reversing gears that differ widely in detail and in general appearance, but agree in that they derive the mid gear motion of the valve from some source that is equivalent to an eccentric with 90° angular advance, and they combine with this motion another that is equivalent to that of an eccentric with no angular advance. The general conception of this form of valve gear is most easily obtained from an example."

We have in another place given farther examples and descriptions from the work. The plates, of which there are 33, are executed in an unusually fine style and ingeniously designed. It is published by Messrs. John Wiley & Sons of New York, and sold here by Messrs. Osborn & Alexander of this City. Price $2.50.

Engineering Magazine—June, 1892.

This number contains a first article on "New York's Commercial Blight," by Mr. Nelson Black, that will be interesting or sympathetic reading for the people of this City. New York and San Francisco are perhaps the only cities in the world peopled by English-speaking people, or any Caucassian people, that present to anyone approaching them, an outward fringe of tumble-down shanties, rum shops and general chaos.

New York is a constant source of wonder to those who land there from the sea. From the battery to Canal street there is scarcely a decent building on the water front, while Washington Market is an intensified disgrace. Mr. Black's article is aided by a number of photoplates showing the water front as it is, and we suggest that a similar exposition here might do some good. New York's shipping business has been driven to Brooklyn and elsewhere. Ours is driven to Port Costa and elsewhere, for overcharges, for bad accommodation, the want of water front warehouses and other facilities. In both cases the control of the land is a main cause of the disfigurement.

Mr. Albert Williams writes of Creede, Colorado, the new mining district that has for some months past engaged so much attention, and with numerous illustrations has furnished a very complete description of the camp—the most reliable perhaps that has appeared. His conclusions are as follows:

"The Camp, taken as a unit as it stands, is undoubtedly a good one, and its output this year may place it in the third rank of Colorado districts—and that is saying a good deal for a newly-opened district. But so far it has not been a "poor man's camp;" the plums have been too few. The mines on the two known ore chutes are yielding well, and have large reserves blocked out, which, from the regularity of the formation, their owners are able to estimate with greater accuracy than is usual in performing that extremely unreliable operation called measuring ore in sight. What they have beyond, they do not know themselves. As to the rest of the district, the prospects in the veins in the eruptive rocks and the prospects in the limestone—well, these claims are just like other prospects. Only by sinking, tunneling, and the use of the diamond drill, will their value or otherwise be determined. A great amount of exploratory work will be done during the remainder of the year, after which a good deal more will be known about Creede than is known at present."

A "Southern Engineer" writes of "Impending Disaster on the Mississippi River," and predicts a disastrous result for the dike or embankment system. The ideas and propositions are not new, but are newly presented. He says of the system:

"Theoretically, and even without any reference to experience, it should be seen that building dikes along the shores of frequently swollen rivers must result in raising the bed over which the water flows. Sediment in great quantities is torn from the banks and carried downward by the flood; and though the great bulk of this sediment is held in solution until it is deposited in shoals off the mouth of the stream, or even carried hundreds of miles out to sea, a still great residuum mingled with rocks, stones and coarse gravel or sand, is precipitated to the bottom of the channel, and there, when the current is permitted to lose its scouring force through the elevation of its banks, it becomes incorporated with the soil and helps to raise it above its former level. Indeed, so manifest is this process, that it may be said that the construction of levees is only carting material to the shore in order that the river may devour and assimilate it on the first occasion when the water mounts to the level of the new barrier. * * * The Po river, in Italy, has been elevated by dikes century after century, until it now flows along the summit of a ridge, its very bottom higher than the surface of the adjacent country, and along this river very disastrous breaks are frequent. But we now know that similar conditions have been created for the Yellow river in China, and that the loss of a hundred thousand lives during a single flood is the not unusual result. Yet the Po would rank among the smaller of the Mississippi feeders, and even the Yellow river is only a moderately great stream by comparison."

This is not a problem of engineering, but of ethics, or economics. People always have, and we fear always will, so long as land is held as private property, guard their own boundary or property. In fact, they must do so, because concerted action throughout the length of a river is not possible, except by a government, and a representative government is not likely to carry out such works unless to promote navigation.

The Sacramento and San Joaquin rivers, as well as many of their tributaries, offer a fine opportunity of a "building up," and have been already raised to some extent. Our engineers know the consequences and have made their views known, but there seems at this time no way whatever to organize or systematize improvements for conservation.

Mr. Hamilton, of Flint, Michigan, writes to correct a common myth respecting explosions acting in one direction, or in one direction more than another, and says the effect is in different directions inversely as the resistance. There are, it is true, some strange results attending the explosion of dynamite in contact with the earth, rock or metals, but such phenomena is no doubt explainable on simple and rational grounds, if it were not so difficult to conduct experiments.

Journal of the Franklin Institute.

No. 797, May, 1892.

In this number a large amount of space is given to various facts and statistics connected with the great exhibition to be held at Chicago. The area covered with buildings will be 160 acres, and their cost, $8,000,000. The estimated expenditure is $18,500,000, exclusive of the portion furnished by the general government, so the whole will exceed $20,000,000. The resources are made up as follows:

"Stock subscriptions, $5,721,230; City of Chicago bonds, $5,000,000; prospective gate receipts, $10,000,000; concessions and privileges, $1,500,000; salvage, $1,500,000; interest on deposits, $33,452; total, $23,754,682."

As, however, these resources, in so far as admission receipts, salvage of buildings and material, are not available until the exhibition closes, the available resources are only $10,750,000 and a government concession or loan amounting to $6,250,000, is counted on. Four thousand men are employed, and the scheme is, on the whole, far in excess of any previous exhibition of the kind. The number of American applicants for exhibition space is 2,082, and the whole number, it is thought, will far exceed any previous exhibition.

A lecture delivered before the Franklin Institute on December 11, 1891, by Mr. Wm. L. Saunders, C. E., on the "Practical Consideration of Compressed Air," is, we suspect, the most valuable contribution on that subject that has ever appeared. It is not a mathematical discussion of thermal quantities and relations, but a practical review and analyzation of all the principal facts developed in connection with the subject of pneumatic transmission and the methods and appliances in use and proposed.

The conclusions are astonishing in respect to the economy of this medium of transmission, and counteracts the common opinions held on this subject. As Mr. Tyndall said in one of his lectures once, there is "hope and promise" of new fields opened up since the Paris system of power distribution has been taken in hand by able engineers.

Mr. Saunders speaks somewhat disparagingly of electrical rock drills, compared with pneumatic ones, in the following terms:

"Electric rock drills are subject to many costly limitations. Thus far they have not been successful, and it is a serious question whether or not it is possible to accomplish the drilling of rock by the percussive principle (which is the only true one) by an electric engine which will be equal in weight, in price and efficiency to an air engine. The weight of a rock drill is one of its most conspicuous limitations, and from every basis of theory and practice a compressed air percussive engine will weigh less than half that of an electric one of the same power. An electric drill is made of copper, which cannot compete in price with iron, and the durability of the apparatus is apparently in favor of the air drill. But as mines are likely to be lighted by electricity, and as there are many conditions of work favoring electric transmission for other purposes, we here have a means by which all the advantages of the air drill are maintained in an electric installation."

The present number contains an exhaustive report on experiments made with a compound locomotive of a novel type, so arranged that the two cylinders, high and low pressure, can be operated as two independent engines, or in other words, as a non-compound engine or a compound one. There is placed between the cylinders an intercepting valve that changes from compound to simple working at pleasure. It is an invention of importance by Mr. C. H. Batchelor, of the Rhode Island Locomotive Works, to whom was awarded the Elliott Cresson Medal of the Franklin Institute for his improvement.

We are of the opinion, however, that a similar method of operating compound or double engines was invented about two years ago by Mr. Byron Jackson of this city, and applied to a traction engine made at his works, and in a manner quite as complete as is shown in the present case.

Transactions of the American Society of Civil Engineers.

Vol. XVI, Nos. 2 and 3, 1892.

In these transactions 282 pages are taken up with a paper on "Some Disputed Points in Railway Bridge Designing," and the discussion thereon. Of this space 112 pages are occupied with Engineer Waddell's paper, 170 pages with the discussion, and as the amount of discussion is a tolerably accurate measure of the value and importance of a paper, we may conclude that the one in question is of that class.

No synopsis of either the paper, or its discussion is possible here, and our object in this notice is to direct attention to what is believed to be a very important essay on a very important subject, by no means settled, according to scientific rules. We had occasion some years ago to notice some of Prof. Waddell's writings on the economics of bridge construction, and methods of letting contracts for county bridges, and so on. If he treats the subject technically, as well as he did economically and commercially, there is much worth examination in the present essay.

Other matter in this volume calls for notice, which our crowded space this month prevents. The transactions form a valuable reference, and compare with those of any association of the kind in the world, in utility, if not profundity.

"INDUSTRY."

JOHN RICHARDS, Editor.

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THE FREE COINAGE PROBLEM.

The *North American Review* for July opens with the usual symposium on current problems, this time on "What Shall the Ratio Be?" Or, to state it in better grammar, what shall the "proportion" be, between the coin value of gold and silver? Papers are contributed by Senators Stewart and Hansbrough, and Congressmen Springer, Bland, and Dalzell, containing useful historical and other information respecting attempts to fix a proportion of value between the two metals, but as usual without any discussion of the real problem of free coinage.

It may seem a bold assumption of Industry to enter into the discussion of this problem, in the face of such eminent authorities as have it in hand, but it will be in place to point out to our readers that nine tenths, if not more, of all the discussions met with do not deal with the true problem at all, which is: what would the effect be on the financial and commercial interests of this country if free coinage was adopted? It is only a waste of time to discuss any point not relevant to this phase of the problem.

What has been done in the past is of no consequence now, except in so far as giving clues and suggestions for the future. This, all must concede and must also admit, that even precedents can have little to do with the matter, unless the value or price of silver has remained uniform, or nearly so.

This is the main point of all. Silver has fallen in value, as all commodities may, gold included, and the present cry of free coinage, divested of its sophistry, means a privilege of taking 90 cents worth of silver to the mint, and by coining, have it converted to $1.29; in other words, adding a fictitious value of about 39 cents, less seigniorage, if any, to every dollar; or to state it still more plainly, to raise the price of silver 33 per cent. by Act of Congress.

Whether such a thing is possible, and if attempted, what its effect would be, we will not attempt to argue. It may, indeed, be left to inference, but this is the plain meaning and object of free coinage at this day. What we wish to point out in the present case is that all the vaporings, harangues and writings, are based on an assumption that the proportion of value between gold and silver has remained the same, we mean independent of their coin use.

This is where the chief sophistry comes in. So long as the value of the two metals bore some definite relation, or some acknowledged relation, based on their intrinsic worth as commodities, free coinage could do no harm, but when by cheaper production and increase of quantity of one metal, or an increased cost of production and scarcity of the other metal, cause their proportion of value to change, all the enacted laws of the world cannot permanently maintain the same proportion between them.

A plain statement is, that gold, because of its increasing use for ornament, money coins, and otherwise, and without a corresponding increase in production, has more than any other commodity maintained its price or exchange value during some hundreds of years past, and for that reason is employed as a *comparative* standard of values, not a *real* standard at all, but as representing a nearly fixed amount of labor, food, clothing, shelter, and so on.

On the contrary, the cost of producing silver has decreased, and it is more plentiful and available in the arts, for ornament, money coins, and other uses, so its price has fallen, obedient to the laws that govern the prices of all commodities, and there it will remain, Acts of Congress to the contrary, notwithstanding.

There is no use whatever in introducing the subtleties met with in arguments on the subject. No one can ever gain a clear or rational view of the matter, except upon the plain and obvious assumption that gold and silver differ in no way as elements of value, from iron, copper, or lead, and only as to their intrinsic value as commodities for use, ornament, and for money coins, which latter is a commercial quality. Here is where the whole controversy must rest when ended. It is the banking, mercantile, and mathematical view of the matter. The other, the "representative value" view, is the "political" one, that by Act of Congress wants to convert 90 cents worth of silver into $1.29 worth of labor, corn, wheat, bacon, wool, timber, coal, gold, or any other commodity. Gold is employed for comparison in the case, because, as before explained, it has remained very nearly at a fixed price for centuries past, that is, a certain amount of gold has more constancy than anything else, and represents more nearly a certain amount of labor, food, clothing, shelter, and so on, during that time, but the comparison of silver is really not with gold at all, only as the latter is a measure of value for other things.

The true comparison is between silver and such commodities as are necessaries of life, gold standing as a nearly constant measure of these, but in no other sense a standard, and, in view of the present discussion, the best way for popular understanding is to drop gold from the subject altogether, and consider silver in relation to other commodities, and wants that it commands.

This, it may be said, would give us a silver standard, which is true, and were it not for disturbing present custom, and for the fluctuations of its price, there can be no objection to a silver standard, any more than one of labor, gold, copper or iron. It is mainly a matter of convenience, but the value of silver as a standard must be adjusted to its "commercial" price, that is, a price based on the cost of procuration, and the importance and desirability of its uses, including that of employment for money coins.

It is, however, unreasonable to find fault with those who have silver to sell, or who can profit by an advance in its price, because they favor and promote free coinage. They have the same right to an inflation of price, and to the same degree, as is enjoyed by those who produce iron, copper, lead or coal. We do not say that a fictitious value of any of these things is desirable or expedient, but that silver men have as much right as others to the personal advantages gained by legislation that temporarily affects the price of their property.

By changes of the kind a few can reap a money benefit, taken from other industries, but a transitory benefit, because in a short time other values adjust themselves to a new standard, and an ounce of silver, or a dollar, no matter what its stamp may be, will buy no more of the necessaries of life than is represented by the intrinsic value of silver contained in the coin.

A special difficulty in considering the case of silver, is, however, because of its use for coin, and because coin has, or is supposed to have, a definite international value. Such use and its adaptability therefor, as before pointed out, constitutes one component in the value of silver, and this far the metal has a distinct commercial quality not possessed by others, except gold; but not for this reason has it any quality that can come under that vague head of "representative" value.

A suggestion offered is, that our readers, in considering the silver problem, leave out the gold question altogether. The two metals are linked together in nearly every paragraph and sentence met with on the subject, while their inter-dependence and corelation is no more than between silver and iron, except that both silver and gold happen to be suitable for money coins, and are so used. Their commercial natures must be considered separate from this fact, except in so far as their quality or adaptability for coins constitutes a part of their commercial value, just as the electric conducting power of copper constitutes at this day a large portion of its market value.

If anyone can show how, in the whole range of commodities entering into commerce, or supplying human wants, any law governing permanent or real values, other than has been indicated, we will cheerfully place our columns at their disposal to explain what such value is, its genesis, and how maintained.

Reverting again to the articles in the *North American Review*, that of Mr. Bland is the most extraordinary. He argues that the size and resources of the country permit and demand special rules or laws respecting silver values, which is much like, and no more absurd as a scientific problem, than to assume that we should have a different method of solving triangles, because their areas are greater here. He says:

"All things considered, we are greater in resources and progressive development than France, England, and Germany combined. Our pressing monetary needs demand a volume of money that cannot be compared to those over-developed countries of the old world. Standing among the nations of the world as a giant among pygmies, why should we ask the aid or advice of baby England, baby Germany, or lilliputian France, in establishing for ourselves a bimetalic system based upon the ratio, or nearly upon the ratio, at which France successfully maintained the bimetallic par for over seventy years, and up to the day of her hasty action of discontinuing free coinage of silver?"

The Congressman will be laughed at, and the wonder is that the editor of the *Review* did not exorcise some of this twaddle, which is not necessary or even relevant to the subject under discussion. The reference to European countries is silly and provincial; especially that to England as a "baby;" a country ruling over more than 300 millions of people, or nearly one fifth of the civilized world; doing just about one half of the foreign commerce of the world, and whose money power is permeating, if not sapping, the industrial interests of this country, by the immensity of "cash" resources.

France is "lilliputian" in a sentence preceding one wherein it is asserted that for seventy years that country established and maintained a definite proportion of coin value between gold and silver.

The whole of the debates on this subject might, without much mistake, be summed up in the words of Charles Francis Adams, senior, who more than twenty years ago, writing in this same *Review*, and in similar connection, of the great "currency debate," said:

"Such vile sophistry, clothed in still viler rhetoric, was never before heard outside a lunatic asylum, and should constitute a matter of special wonder to ourselves, as it doubtless will to succeeding generations."

A PROBLEM IN LAUNCHING THE PACIFIC MAIL STEAMER "PERU," AT THE UNION IRON WORKS.*

BY HUGO P. FREAR, NAVAL ARCHITECT

The problem of launching the Pacific Mail Company's Steamship *Peru*, now building at the Union Iron Works, San Francisco, rendered it desirable to make certain computations before laying the ways, and becoming interested in the subject the author decided to construct launching curves and scales for reading the technical conditions of the vessel from the time she started to move until she was water borne.

The problem which prompted him to make the curves is special, and while expecting to make it the feature of this paper he took particular interest in harmonizing the different curves and scales so that there would be a fixed relation among them, and in adapting them to solving any problem in the statics of launching.

In order that the reader may see clearly why the *Peru* was placed under her present conditions of launching, and better understand the problem, we will describe briefly our building slips, after which the article will be divided into two heads.

*Read before the Technical Society of the Pacific Coast, July 1st, 1892. Reprinted by permission

First.—The reasons and possibility of building and launching her under the present conditions.

Second.—The problem of launching her under the present conditions, both from an economical and technical standpoint.

The floor of our slips consists of a wharf, piled, capped and planked, which has an increasing inclination toward the water. There are permanent standards on each side of the slips which assist in carrying the staging for construction. They are spaced twelve feet apart, and support common roof trusses at the top, which span the slip-ways and support-tracks for overhead traveling cranes. Thus, it will be seen, that the vessel, if placed in one of our present slips, must be built under a permanent structure which has a limited height.

The reasons for placing the *Peru* under these conditions for launching date back several months before the contract was signed, and were entirely from an economical standpoint.

The wharf and structure overhead for a new slip sufficiently large enough to accommodate the *Peru* would cost about $40,000, and made the possibility of building her in one of our present slips a very important question to settle before taking the contract.

Over a year ago I was requested to make a profile of the only available slip we had, and lay in a vessel of the *Peru's* dimensions, and determine definitely whether she could be built and launched there.

This was done as requested, and I reported that it was possible, but that we would be very much cramped for room. There was barely height enough for the *Peru* to squeeze in, and launch at an inclination of a half inch to the foot. This allowed the fore foot to clear the edge of the wharf by six inches, while the top of the stem would pass along just under the lower chord of the rafters overhead, which, by the way, are in a plane also inclined toward the water one half inch to the foot. The minimum clearance on each side was only six inches.

We will now assume that the keel has been laid and the frames erected, and that the vessel will be launched in four months. This was about the time that instructions were given to determine how far the piling would need to extend beyond the end of the wharf for laying the ways. This information was wanted at this early date because there were other piles to drive, and the Superintendent, Mr. Dickie, wanted to have the work all done at once.

The problem, pure and simple, was to lay down a line for the launching ways:

First.—Such that the vessel in taking the water would not dip down at the stern, or tumble over the end of the ways, and consequently lift at the stem, and thereby carry away some of the rafters overhead.

Second.—For economy to drive as few piles as possible.

In other words, the vessel was to be got into the water as soon as possible without carrying away anything.

There are a few facts which must be known before making the calculations.

First.—The proportions of the vessel.

Second.—Exact position of vessel in relation to the wharf and superstructure.

Third.—Weight, and fore and aft position of the center of gravity of the hull.

Fourth.—Exact water level at time of launching.

Fifth.—To determine the launching line.

FIRST DIMENSIONS.

Length over all	346 ft. 0 in.
Length between perpendiculars	326 ft. 0 in.
Breadth	45 ft. 0 in.
Depth	27 ft. 6 in.

Second.—In obtaining the position of the vessel in relation to the wharf the work was done from her keel, which was straight except where it rounded up at the fore foot. A surveyor's level was used to determine the inclination of the straight part of the keel, which was 1 in 29.003, and then laid down her profile at the correct inclination. We then measured down from the keel to obtain the profile of the wharf, and measured up from the wharf and obtained the position of each rafter. It was necessary to make the measurements very carefully, as both the line of the wharf and rafters were very irregular.

Third.—It was not so easy to find the weight and center of gravity of the hull four months before launching, and it required considerable speculation, because no one could predict exactly what stage she would be in at that time. As an over estimate was on the safe side, because conditions entirely beyond our control had to be dealt with. The following estimated weights were assumed, which would probably be aboard unless we were hurried in the launching.

Plates	2,166,507	pounds.
Bars and shapes	1,066,600	"
Stern post	13,000	"
Rudder	5,127	"
Keel	33,525	"
Stem	4,158	"
Deck Stanchions	34,988	"
Miscellaneous forgings	6,000	"
Cement	155,000	"
Rivet heads	60,000	"
Wood decks	367,500	"
Wood ceiling	180,000	"
Deck and ceiling bolts	10,000	"
Cargo port frames	8,000	"
Engineers' work	139,721	"
Paint	12,000	"
	4,262,126	pounds

or 1,903 long tons, which we will call 1,900 tons throughout our calculations.

For finding the fore and aft position of the center of gravity, and the distribution of weight, a curve was constructed, which we will call the curve of loads for hull. (Shown in the diagram, page 628.)

The vertical ordinates of this curve are on a scale of 250 pounds = one foot, and each ordinate, one foot apart, represents the weight of one foot of length of the ship in a corresponding position. The area of the curve equals the weight of the whole ship on a scale of 250 pounds to the square foot. Therefore the center of gravity of the area within this curve corresponds to the fore and aft position of the center of gravity of the ship.

This was found by the use of Simpson's multipliers. This method was chosen because it is simple, and, if desired, curves for shearing and bending stresses for any given position could be constructed.

Fourth.—The water level was not much easier to guess than the weight, because the tide varies every day, and the calendar tide is not always reliable to a few inches. The tide assumed was five feet, and the correct position of this is shown in the diagrams.

Fifth.—The launching line must be determined by trial. At this stage we knew the vessel could be launched at an inclination of half an inch to the foot. If she slid until the stem passed the last rafter it was found by approximate figures that the stern was far from being water borne, and even if the stern was allowed to drop down, or over the end of the ways as in the case of most vessels, the piling for the ways would have to extend approximately 230 feet beyond the end of the wharf. This would require 230 piles at about $15 each, or $3,450, besides capping and timber for ways.

It was then decided to launch the *Peru* on a curved line. In determining the curved line the mean, initial inclination had to be settled, and be sufficiently great for the vessel to start. It was decided to make it 1 to 25 for the inclination of the chord on the length of the cradle at the starting position. As small inclination as possible at the beginning was desirable, because we could get a quicker curve, and that would enable us to reach the water sooner than a slight increase of inclination at the start.

At this point it became necessary to settle on the length of the cradle, and owing to the fineness of the ends of the vessel, found it impracticable to make them over 244 feet. We found a rise of arc of 12 inches on a chord of 244 feet, or the length of the cradle was as great as could be obtained, because with this spring the top of the cradle came within 2 inches of her bottom, and the underside of the ways rested on the lower end of the wharf.

At this inclination and curvature it was necessary to cut the forward chock down to the forecastle deck beams which would clear the rafters by 7 inches, and the fore foot also cleared the wharf by 4 inches. This would allow the vessel to settle 2 inches from the time her keel was laid until she was on the launching cradle, and still have 2 inches to clear the foot of the wharf. This is sufficient with our system of lashing the forward poppets, but gives a very small margin.

While we will keep on the safe side, and assume that our initial mean inclination is 1 to 25, let us state here, that again owing to the fineness of her ends we were obliged to place the center of the cradle 13 feet forward of the center of gravity of the hull, and that the inclination of the tangent to the curve at the center of gravity of the hull is 1 to 23.522. At this inclination and pressure per square foot, which is 2.688 tons on the estimated weight, there should be no question about the vessel starting.

While the curves and scales have a graphic as well as a real relation to each other, and for any given position of the ship the corresponding data can be traced to each, they will be divided into four groups, and those placed together which seem to have a closer relation. In describing them we will take them up in the natural order of performing the work.

FIRST GROUP.

A.—Scale-measuring distance vessel has traveled at various draughts.

B.—Draught curve measured from top of keel.

C.—Buoyancy curve.

The fore and aft ordinates are measured in a horizontal direction, and the slight difference due to the curvature of the ways has been neglected.

The vertical ordinates of all the curves, except the one described and the draught curve, are measured from the top of the keel, because the displacement practically begins at this point.

The *Peru* slides 50 feet before she begins to displace any water, and this is made the zero point for the base or first scale *A* which measures the distance the vessel has traveled at various draughts until she drops off the end of the ways. Draw a vertical line from this scale at 50 feet from zero, and start the draught and displacement curves with their respective zero points in this line.

Then when the vessel has slid 50 feet she draws 0 feet of water, and displaces 0 tons of water. The vessel was slid down the ways, and vertical lines drawn from the sliding scale corresponding to each 2 feet of draught and the displacements calculated. At 177 feet of travel she draws 10 feet of water and displaces 245 tons; at 222 feet she draws 14 feet and displaces 680 tons, and so curves were constructed so one can read the draught and displacement for any intermediate points, as, for instance, at 13 feet 7 inches draught she has traveled 218 feet and displaces 630 tons. This happens to be a point in our curves which we will consider later on.

In finding the displacements at various draughts of water there was made an outline tracing of the hull and line of the ways, and the tracing was slid over the drawing in the direction of the water, and care taken to keep the line of the ways coinciding with that on the drawing, and the water line traced on for each successive 2 feet of draught up to 20 feet. The displacement was thus found (and also fore and aft center of buoyancy, which will be used in the next group of curves) by means of a planimeter and Simpson's multpliers.

The draught curve if inverted, and turned end for end, would correspond to the locus of the keel of the vessel, and therefore is a part of a circle until the 18.521 feet draught is reached, a point which we will consider later. The depths for dredging for the launch were taken from this curve.

The scale of feet adjoining the draught curve measures the ordinates of that curve, and the scale of tons to the extreme right of the drawing measures the ordinates of the displacement curve. Reference to the drawing will show the scales to which each curve has been constructed.

SECOND GROUP.

In approaching the second group it will be again stated that the *Peru* is to slide on the ways until the water lifts her up at the stern so that her fore end will not lift up, therefore the vessel will pivot or hinge about the fore end of the cradle, and will just be ready to hinge when the moment of the ship acting down about the fore end of the cradle is equal to the moment of buoyancy acting upward about the same point. This is the critical point we are about to determine by means of our second group, which consists of

D.—Fore and aft position of centers of buoyancy.

E.—Moments of buoyancy about fore end of cradle.

F.—Moment of ship about fore end of cradle.

As stated above, the center of buoyancy for each successive two feet draught of water was found while using Simpson's multipliers for obtaining the displacements. In plotting the curve there was drawn fore and aft lines parallel to the keel, through points in the buoyancy curve corresponding to their respective draughts and displacements, and spotted the correct center of buoyancy for each, on its respective line. In obtaining the curve of moments for buoyancy the displacement in tons were multiplied, for each successive draught, by the distance respectively of their corresponding centers of buoyancy from the forward end of the cradle, measured in feet in a horizontal direction.

These products gave the moments in foot tons of the force of buoyancy tending to make the *Peru* hinge about the forward end of the cradle, or the pivoting point. The points in this curve are spotted on vertical lines drawn through the respective points in the curve for centers of buoyancy to a scale of one foot equals three thousand foot tons.

The moment of the vessel acting down about the forward end of the cradle is a constant quantity, and is equal to her weight multiplied by the distance of her center of gravity from that point, also measured in feet in a horizontal direction. As this moment is a constant quantity, its curve becomes a straight line as shown in the cut.

It has been stated that the *Peru* would be ready to lift up at the stern when her moment acting down about the forward end of the cradle is equal to the moment of buoyancy acting upward about the same point. The intersection of these two curves, or rather the curve and straight line, show exactly when this should occur, taking into account only the statical forces of still water acting on a ship without momentum. These conditions will be touched upon later.

THIRD GROUP.

The third group of curves consists of

First.—The points G of application of land-borne weights at the various positions in relation to the vessel, or the position on the vessel of the centers of gravity of that part of the weight carried on the ways.

Second.—The curve H showing the loci of these same points in relation to the wharf as they move along with the vessel, and which show the various positions where the weights, acting through these points, are carried on the supports under the ways.

Third.—Curve J for determining the maximum length of ways for fulfilling certain conditions.

It is evident that if the vessel weighs 1,900 tons, and a part of that weight is carried by the buoyancy of the water, the balance of the weight must be carried on the ways or the earth ; and the center of effort on the ways must be forward of the center of gravity of the vessel, a distance equal to the buoyancy multiplied by its distance aft of the center of gravity of the vessel, divided by the weight acting on the ways for a given position ; or let $W =$ weight of the vessel, $D =$ the force of buoyancy, $W - D =$ land-borne weight, $Y =$ distance D is aft of W, $X =$ distance $W - D$ is forward of W. Then $YD = X(W - D)$, or $X = \frac{YD}{W - D}$

From the curves already plotted, D and Y are known ; $W - D$ is also easily found, and therefore the value of X can be found for any position, and the curve plotted for the amount and point of application of the land-borne weights.

The land-borne weights vary from 1,900 tons to 0, as the vessel takes the water.

The abscissæ of this curve are measured forward of the vertical drawn through the center of gravity of the vessel, on lines passing through corresponding points in the displacement scale. The scale of tons to the right, measures the buoyancy up to any given one of these lines, and the balance of tons measured on this scale measures in tons the ordinates of the curve for land-borne weights. Therefore, if this scale of tons is inverted, it would give the correct reading of land-borne weights in tons, for any data selected from any of the other curves or scales already described ; as, for instance, when the *Peru* has traveled 268 feet, she draws 18.521 feet of water, and displaces 1,475 tons ; the center of buoyancy and center of land-borne weights are then shown by the curves, and the land-borne weight is 425 tons, as measured by the scale to the right and adjoining this curve. This curve shows the center of weights in relation to the ship, each of the points being, as it were, fixed with the vessel. The distance each of these points has traveled can be readily traced to the scale *A*, before described.

If each of the points are moved aft, as far as the vessel has traveled, as read from the scale just referred to, and a curve *H* drawn through them, this curve would show the points of application of land-borne weights in relation to the end of the wharf.

The vertical ordinates of this curve are equal to the respective draughts of water, as measured by the scale to the extreme left. This scale is four times as large as the first draught scale described, so the curve would not be too flat to read accurately.

The next curve *J* is for the purpose of determining the end of the ways. It was decided that the ways should be of such a length that no pile supporting them should be allowed to carry over 14 tons until the vessel lifted at the stern. This curve is constructed to exactly fulfill this condition at each point. Each launching way is supported by a pair of piles every four feet, and as there are two launching ways, there is an average of one pile per running foot of ways, and consequently under the above condition there would be a load of 14 tons per running foot of ways.

The curve *H*, described above, shows where the center of land-borne weight is carried for each position of the vessel. In distributing the weight over the ways, half would be carried forward and half aft of the center of application on the ways.

Therefore, if the weight for each point was divided by 2, and again by 14, the quotient would be the number of running feet of ways aft of the center of weight for the given position of the vessel ; or let $W - D =$ weight for any position, then $\frac{W - D}{2 \times 14}$ would give the number of running feet of ways aft of any given point on curve *H*, and a curve *J* drawn through these points would determine the end of the ways for fulfilling the above condition for any position of the vessel, and the point to the extreme left of this curve shows the minimum length of ways for fulfilling the conditions of 14 tons per pile, for the position of the vessel producing the greatest weight on the end of the ways, before she lifts at the stern.

It will be noticed that the *Peru* is drawing 13 feet 7 inches of water at this point. She has traveled 218 feet, weighs 630 tons in the water, and 1,270 tons on the ways. At this point, curve *G* is just beginning to change from nearly a straight line to a pronounced convex shape, which shows that the center of land-borne weight is beginning to travel forward much more rapidly in its relation to the ship. Curve *H* shows that this center of the land-borne weight is fast approaching a point where it travels forward on the vessel at a velocity equal to the speed of the ship, or where it becomes instantaneously stationary as far as its actual speed over the ground is concerned.

Here the displacement is increasing so rapidly, and the land-borne weight is decreasing at the same rate, so that the distance between the two curves *H* and *J* is decreasing faster than the points on *H* are traveling aft; and that is why the maximum length of ways is required earlier than when the center of land-borne weight is at its greatest distance from land.

This ends the problem of the paper proper, namely, to find the minimum length of ways for a load of 14 tons per pile, until the vessel is lifted at the stern. But it would be hardly right to stop here without constructing our curves until the cradle on which the vessel rests, is entirely clear of the ways.

All the curves have been constructed thus far, up to the point where the vessel lifts at the stern. The scale *K*, at the extreme bottom of the cut, shows how much of the cradle remains on the end of the ways at this point. The zero point is placed at the extreme right, or under the point where scale *A* indicates that the cradle drops from the end of the ways.

The scale is, of course, 244 feet long, or equal to the length of the cradle. The 244 foot reading is the point where the after end of the cradle has just reached the after end of the ways. Scale *A* shows that the vessel has traveled 132 feet up to this point, and any of the vertical lines drawn through scale *A* to scale *K* will show the length of cradle remaining on the ways for any particular distance the vessel has traveled.

Thus when she has traveled 268 feet, or the distance where she begins to lift at the stern, scale *K* indicates that there are 108 feet of cradle remaining on the ways.

The curves up to this point have been constructed on known draughts. After this the displacement and center of buoyancy is determined before the exact draught is known. From now on the moment of buoyancy and moment of hull, acting in opposite directions about the forward end of the cradle, will be equal with the forward end of the cradle resting on the ways, until the vessel drops or floats off. The draught of water must be such that the above conditions will be fulfilled.

Slide the vessel down the ways with the upper end of the cradle resting on them and find the displacement, center of buoyancy, and moment of center of buoyancy for three different draughts of water within limits between which the draught required will probably fall. Draw trial curves through these points, and then the exact center of buoyancy, displacement, and finally the draught of water for fulfilling the conditions of equilibrium can be traced from the point where the trial curve of moments for centers of buoyancy intersects the line of moments for hull. This process is gone through with for as many points as are desired for constructing the above curves. The method of constructing the other curves is the same as already described.

The most important curve from here on is that for the land-borne weights. The whole of this weight theoretically comes on the forward end of the cradle, but practically the forward poppets crush down from one to three inches, and better distribute the weight.

Curves *H* and *J* show that the greatest weight comes on the ends of the ways just before the cradle drops off. The only way to obviate this is to build the vessel more nearly in the trim she will assume after she is launched. Shallow, full-ended boats have often broken their backs because they were built at too great an inclination.

The work described, a great deal of which is of a speculative nature, was performed three months before the vessel was launched. The above, too, was written before the launch, because it was thought that the steps and uncertainties which led to it would be more interesting than a bare description of curves constructed when the data consisted entirely of known quantities.

It would be interesting to note the difference between estimated and actual results.

First.—The *Peru* was launched the 11th of June, 1892, at eleven o'clock at night, instead of the middle of July.

Second.—She only weighed 1,680 tons, instead of 1,900 tons.

Third.—She cleared the rafters 12 inches instead of 7 inches.

Fourth.—The tide did not come up within fifteen inches as high as there was every reason to expect. It happened that the tide rose to within half an inch of where it had been assumed, and although it was a calm bright moonlight night, the tide was fifteen inches lower than recorded two or three weeks before, for the same calendar tide, under conditions apparently less favorable.

Fifth.—The pressure per square foot of greased surface was only 2.376 tons instead of 2.688 tons.

Had the *Peru* remained in the slip a month or five weeks longer, she might have weighed 1,800 tons, or 100 tons less than the weight used throughout our calculations. This overestimate will seem excessive to those unaccustomed to building and launching ships over piles driven in soft mud.

The *Peru* settled 2 inches on the keel blocks while building, and she settled 1¾ inches at the stern, and 1¼ inches at the stem, during the last two hours before she was launched, and perhaps the piling settled enough more to cause her to clear the rafters 12 inches instead of 7 inches. She only cleared the foot of the wharf by half an inch instead of 4 inches.

There were only two ways of being on the safe side. One, to over estimate the weight, the other to come closer to the weight and then drive a few extra piles.

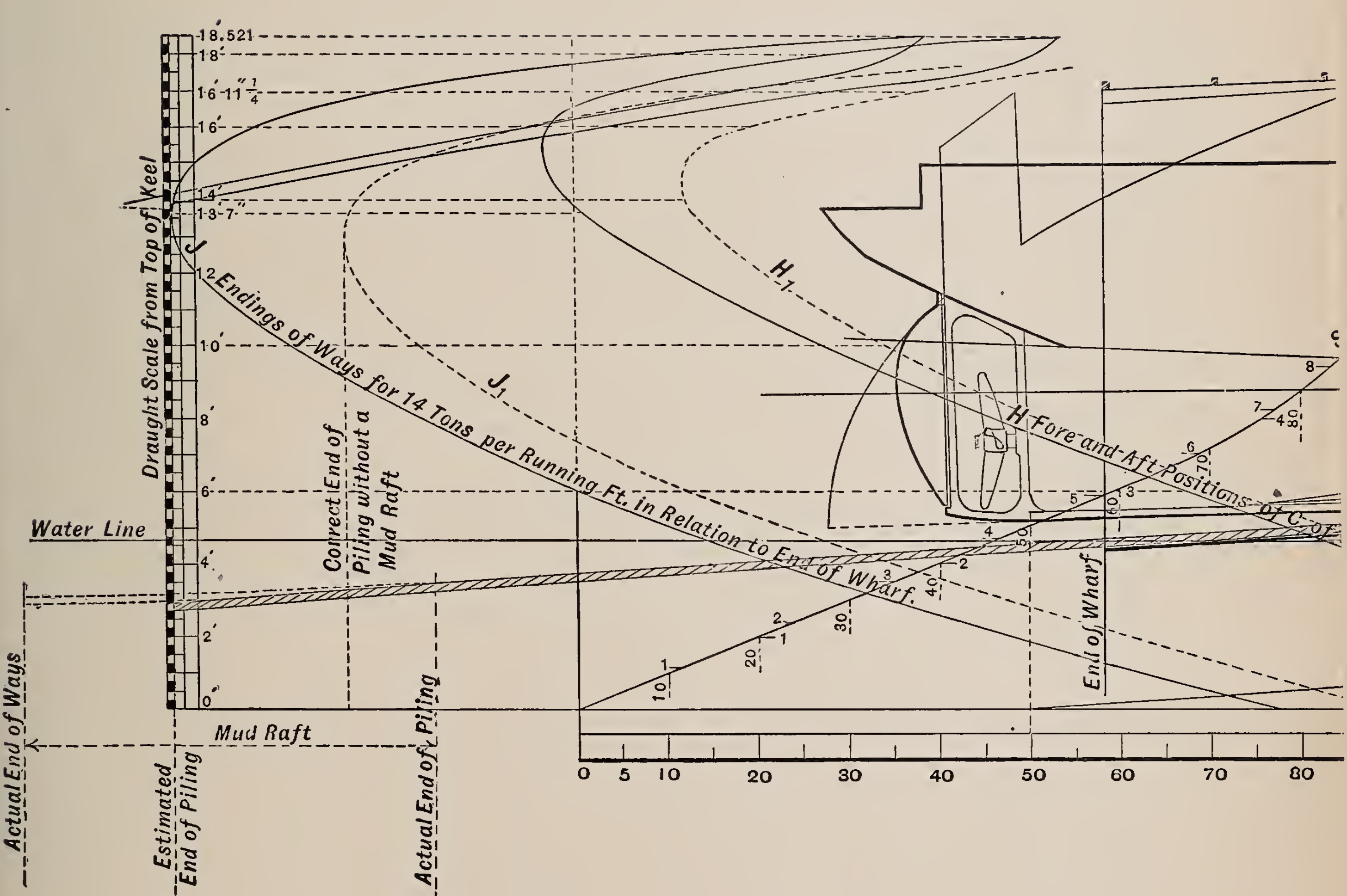
After these calculations were made, and before the piles were driven, we hoped to get at least 6 inches more water than had been assumed, even if we had to launch at midnight. It was also decided to stop the piling 28 feet short of the calculation, and from that point build a mud raft or crib 16 feet beyond the projected extreme ends of ways for supporting them. This was almost as good as piling because the outer end was elevated 23 inches, and had to be depressed that amount before the vessel could pass; the drawing shows these alterations. We have been accustomed to launching over a mud raft for cushioning, as the vessel tumbles over the end of the ways. This relieves the vessel of strains which are sometimes serious, and prevents the grease from being cut at the end of the ways, and causing the vessel to stick. Where the vessel is to "hinge up," as in our case, the mud raft is of use only for lengthening the ways. A rigid point at the end of the ways is no

Technical Society of the Pacific Coast

"A Problem in Launching"

by

Hugo P. Frear



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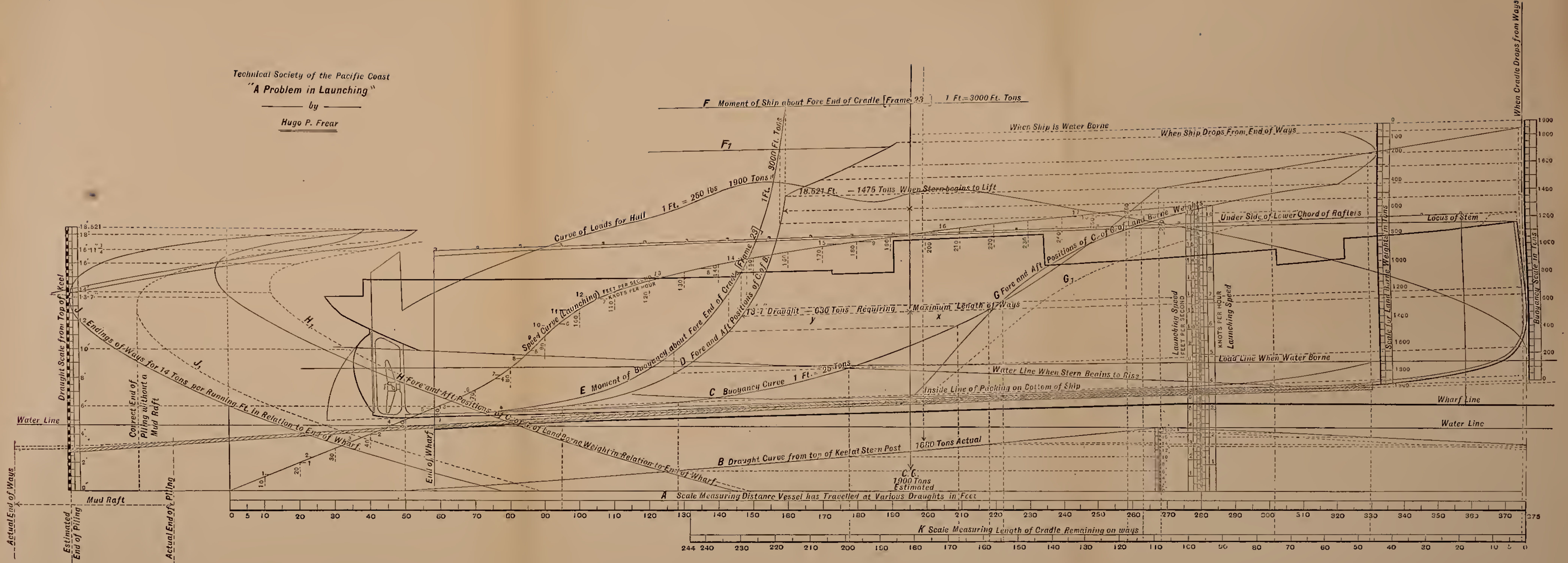


objection because the weight is lifted here, and comes on the forward end of the cradle. If it were possible to well cushion this point, it would be an advantage.

The curves F_1, G_1, H_1, and J_1 have been altered for the correct weight of the vessel, and are shown in dotted lines. The curve J_1, shows that the mud raft could have been dispensed with if the piles had extended nine feet further from shore. In conclusion, it will be said that in making the calculations the momentum was ignored for two reasons. 1st., because there was no data. 2nd., it could not affect the length of the ways in our special case, because according to the curves, the maximum length of the ways is required when she has traveled 218 feet. The calculated lifting point is reached when she has traveled 268 feet, and the length of ways required to fulfill the statical conditions of 14 tons per pile could be 82 feet, less than the maximum, at the point where she lifts up, consequently, even should her displacement remain constant, she could travel on in the same circular direction 82 feet and still weigh only 14 tons per pile. The stem would continue in the same circular locus until the stern lifted, as it inevitably would. The only difference would be a little more draught of water, which is of no consequence with our soft mud for a bottom.

The *Peru* was making over 10½ knots per hour, or about 18 feet per second, and so her momentum must have been a considerable quantity, and if she actualy lifted where the curves said she would, the total energy of the wave at that time would, presumably, just measure the momentum. A curve of speed at the various positions during the launch has been placed on the drawing.

THE ETHICS OF ADVERTISING.

The industrial advertisers of our day, that is the merchants, manufacturers and engineers, are indirectly taxed to support a very important branch of our educational machinery — the technical press.

It may be unfair, no doubt is so, but it is not the publishers' fault, or even his desire to furnish a technical journal at a price that will not pay for the bare paper it is printed on. This is not an extravagant statement, on the contrary is true of many technical journals, and, as it happens, some of the best ones that can be referred to.

In so far as the publishers it comes about by spending on the reading columns the revenue derived from advertisements, and is laudable in one way. We have in mind now two leading technical journals of high standing whose sales do not begin to pay for the "make up" and matter, although the subscription price is high and the circulation large. The matter is paid for, and well paid for, as all ought to be that has any value. The advertisers foot the bill, and have with others the advantage derived from a dissemination of information that has a definite money value in business.

As nearly all people engaged in industrial pursuits contribute to this very worthy object, the benefits are to some extent equitably distributed, but there are, here and there, firms and companies that use and derive benefit from technical journals without contributing so much as the cost of the material in them. They are content to live by the labors of others, and have in their favor the argument that no one need publish such a journal unless they want to.

We are not framing a plea for INDUSTRY in these remarks any more than for any other publication that is made up with useful matter to the limit of its revenue, but have in mind certain firms, on this Coast and elsewhere, that are, in their business, much more than they suppose depending on the information derived from serial publications, but do not in any way contribute to their support.

The principals of firms may not read such literature, and may not need it, but some person connected with their business must do so. How long would any skilled industry, or a commercial business, last if cut off from current technical information? Not long we imagine. In fact a good measure of a firm's capacity is how far they are informed in the progress of the day in respect to their own and connected branches of industry.

That there are many useless and impotent publications seeking patronage is too obvious for argument. Some of them provided with a "desk and assurance" for capital, the advertisers being expected to not only contribute current expenses, but also the working capital in the business. There is also the charge of wily misrepresentation that can be brought forward in too many cases, but, as before pointed out, there is another side to the question, and there are, let us hope, a good many technical and trade publications that attempt, to the full limit of their power, to return *quid pro quo* for advertising patronage, not only by dissemination of the advertising matter but by its environment; we mean the make up of the reading matter.

On this Coast, for example, the business problem is, will people come here to buy, or will they purchase elsewhere? People are apt now-a-days to make a journey of inspection ; coming here from Australia, Mexico, Central and South America, or from the Coast above and below San Francisco, and while a good many of our people may never suspect or think of it ; the "influencing impressions" of such buyers are largely drawn from what they read, especially on their journey here, while here, and on their way to the East. The influences thus provided are not easy to trace, but if that were possible, it would be a matter of astonishment to know what is contributed in a business way by the local literature of the Coast.

THE TEHUANTEPEC RAILWAY.

The Mexican Government has had in hand, for some time, the making of a railway across the Isthmus of Tehuantepec to connect the Atlantic and Pacific Oceans. This railway, which should have been built long ago, was began and abandoned some years since by an American company, and afterwards was taken up by the Mexican Government, who have built two thirds of the line, and will have the rest done within less than two years to come.

The road will be 164 miles long, and, as we believe, nearly on the line projected for Captain Eads' ship railway that engaged so much attention ten years ago. The line is nearly straight, with easy grades, and rises only 785 feet in crossing the hills through a convenient pass. The Pacific terminus is at Salina Cruz, a sufficient harbor. On the Atlantic side the harbor will require dredging, which is now in progress.

This route is shorter than the proposed Nicaragua Canal, and is more than one thousand miles shorter than the Panama route from here to New York. It also shortens the distance to New Orleans nearly two thousand miles, and will, so far as can be now seen, be an important matter to this City and the Pacific Coast.

The Mexican Government propose to open the railway to all nations, or to all steamship lines, a resolution which will, no doubt, be adhered to so long as the Government lasts under President Diaz, and, no doubt, perpetually ; because Mexico is learning the folly of choking and impeding commerce into and through her ports and country, and if properly managed with reasonable tolls there is no doubt but what the line will pay a large revenue to the Government, especially if the handling facilities are so contrived as to save expense, and avoid damage to goods.

The principal function of this railroad, in so far as this Coast is concerned, will be to break up one of the most shameful monopolies that has ever existed—the Pacific Mail Company's control of the Isthmus route via Panama. It is to be questioned if there is another government in the world that would permit such an obstruction to commerce and travel between two sections of their country. The Isthmus route is at present, and has been for a dozen years past, an appendage of the trans-continental railways, and of no use whatever, being subsidized and controled by the Gould interests at New York, and the Southern Pacific Company here.

The astute managers of the railway lines have been trying to purchase the Tehuantepec one, and are reported to have offered $8,000,000 for it, a fact that goes to prove what we have all along contended for in respect to the Nicaragua Canal, that the railways would not permit such a competitor, and unless the Canal was owned, controlled and operated by the Government it would never be of any use to commerce. The supineness with which such things are viewed in this country is amazing, and we suggest that the Tehuantepec line should become the subject of a special treaty with Mexico, if that be necessary.

THE NICARAGUA CANAL.

We have received a pamphlet on this subject, written by Mr. N. J. Manson, of this City, which so completely presents certain views that have been less ably set forth in this Journal, that we take the liberty of transcribing from Mr. Manson's essay, some of the most striking portions of it and recommend our friends to read the whole pamphlet, if they have any interest in this important matter.

Mr. Manson's position briefly stated is, that the Nicaragua Canal scheme is a Government one, which for half a century past has engaged the attention of the Government and people of this country. Vast sums have been spent in surveys and investigations respecting a canal across Central America, and that now a private company, partly foreign, have wedged themselves in between the United States Government and this work, with a view of having the country provide funds to construct the canal, which is then, by the terms of the bill now before Congress, to be turned over to private control, to tax commerce at discretion for a period of 198 years. This is done under the name of "aid" and on an estimate for the work, nearly twice as great as that made by the Government engineers.

In respect to this Coast Mr. Manson says:

"With the settling up of the Pacific Coast came the demand of its people for cheaper freights, so that they might enter the markets of the world with the bulky and nearly exhaustless supplies of the finest lumber known and of the most varied adaptabilities; with the product of their mines, of copper, lead, zinc and iron in equally yields of agriculture, with the wonderfully varied and enormous fisheries. The demand for a cheaper and closer union between the East and West and the markets of the world increases; it appeals to the nation for relief from enforced inactivity and from suppressed industries.

In this later day of the world's advancement and of the aggressions of nations, the considerations of national unity and national defense point unmistakably to the importance of strict and entire governmental construction and control of an interoceanic canal. A free Isthmian canal, constructed, operated and controlled by the Government of the United States, is the indissoluble bond of interest and affection, destined alike to join a now divided domain, to restore to the United States commercial supremacy on the high seas, and to give to the crippled industries and occupations of the Pacific States freedom from existing extortionate and paralyzing freight rates over long lines of railway communication between Eastern and Western markets."

Of the Nicaragua Canal bill reported in the Senate of the United States in January 1891, the author says:

"Under the provisions of the Bill of January 10th, 1891, reported to the Senate of the United States by the Committee of Foreign Relations of the Senate, the Maritime Canal Company of Nicaragua, a private corporation, is to cause to be printed by the Bureau of Printing and Engraving in the City of Washington, and to issue its coupon or registered bond, or both, to the extent of $100,000,000, payable in twenty years, bearing interest at the rate of three per cent. per annum, payable quarterly on the first day of April, July, October and January of each year. These bonds, under the provision of the bill, are to be secured by a first mortgage on the Company's property and rights of property now existing or hereafter acquired, including all concessions and franchises to the Company.

The Secretary of the Treasury of the United States is to cause to be printed on each of these bonds the guaranty of the United States to the lawful holder of the bond, the payment by the Maratime Canal Company of Nicaragua of the principal of the bonds, and the interest accruing thereon, and as it accrues. These bonds are to be paid out to the Company by the Secretary of the Treasury of the United States at intervals of at least every sixty days and as work on the canal progresses.

In return for its guaranty, the United States is to be subrogated to all the rights and liens under the mortgage which the holders of the bonds would have had, for all moneys, whether principal or interest, that it has to pay under its guaranty. The incorporation shall have fifteen directors, seven of whom shall be elected by the stockholders ; six shall be appointed by the President of the United States, by and with the advice of the Senate of the United States, one is to be appointed by the Government of Nicaragua, in accordance with the terms of its concession to the Company, and one by Costa Rica, by the terms of its concession to the Company.

The capital stock of the Company is to be limited to 1,000,000 shares of $100 each. $70,000,000 of these shares shall be issued to and in the name of the Secretary of the Treasury of the United States, to be held in the Treasury of the United States as a pledge to secure the Government for any sums it may have to pay under its guaranty. The United States is to have the option at any time of purchasing these shares at par.

Six million dollars of the shares are to go to Nicaragua in accordance with the terms of its concession, $1,500,000 of the shares are to go to Costa Rica in accordance with the terms of its concession. Stock and bonds not exceeding $7,000,000 are to go to the promoters of the present enterprise for securing the concession and for doing what work has already been done on the Canal. The remainder of the stock, amounting to about $19,000,000 of shares shall only be issued by the Maratime Canal Company of Nicaragua after it shall have been subscribed for, and when in the opinion of the President of the United States the proceeds of the installments of the mortgage bonds are insufficient to meet the current requirements of the Company in respect to the enterprise. This, in brief is a statement of the main features of the bill under which the Nicaragua Canal is proposed to be built.

The United States, under the terms and provisions of this bill, would place itself in an attitude towards the commerce, the industries and the business of the country that it has never seen fit to assume in regard to any intraterritorial water communications of much less importance.

Had it for instance, with regard to that great highway of commerce, the Mississippi River system, allowed a syndicate of capitalists, with or without the financial backing of the Government, to improve that great artery, now throbbing with the healthful pulsations of a free and unrestricted commerce, and bearing on its currents to the sea, thence to be borne to the uttermost parts of the world, the surplus products of its various climates, of its populous and manufacturing cities and its untold treasures of mineral wealth — what would be the condition of its now prosperous people if the policy of the Government had subjected them to the grasping toils and exactions of some Mississippi River Improvement Company? The Government, first and last, has expended on this river and its tributaries many hundreds of millions of dollars, and the country has voted it wisely spent, for the reason that it put it out of the power of any and all incorporations, combines of capital and trusts to exorbitantly tax with freight charges the industries and occupations of that entire section.''

The author next shows how the ''Nicaragua Canal Construction Company,'' which is the same thing, in fact, as the ''Maratime Canal Company of Nicaragua'' a ''Credit Mobilier'' arrangement, has followed on the lines of survey made by the Government, and in that manner appropriated what belongs to the Nation, and has cost as before said, vast sums to complete. He says ;

''The Maratime Canal Company of Nicaragua seeks to control the only practicable line of water communication between two oceans at their middle point. It seeks to bisect a hemisphere, so that the trade and developments of 12,000 miles of coast line on the western side shall in seeking the markets of the East, pay to the Maratime Canal Company of Nicaragua the price of their very development and existence. It seeks the returning trade. It does not content itself with exactions and tolls upon the coastwise commerce of one nation, however extensive ; it seeks tribute from the commerce of the world. It seeks not only to place exactions upon the commerce of oceans which have that of lakes and seas and mighty river systems for feeders, but it seeks through them to tax the internal commerce of nations. It seeks to control and oppress the commercial prosperity of nations, by tolls and exactions upon the occupations and industries of man, at the point where nature itself is working, not for his injury and oppression, but for his relief and enfranchisement.

It seeks this vast monopoly in the face of the often-declared policy of this Government with regard to an interoceanic canal. It seeks it at the very point of governmental survey and location, at a point frequently surveyed and reported to the Government of the United States by its officers as the most desirable point for an interoceanic canal, and the object of more than one treaty between this Government and Nicaragua.

It seeks this monopoly in the face of President Fillmore's announcement to the Congress of the Nation, when, as far back as 1851, he stated : 'In investigating upon this important subject, the Government has had in view one, and only one object ; that object has been and is the construction or attainment of a passage from ocean to ocean, the shortest and best for travelers and merchandise alike, and equally open to all the world.'

It seeks it at the sacrifice of the true interests of the Pacific Coast of the United States, including Alaska, whose future prosperity and greatness depend, it may be said, exclusively upon the removal, by the Government of the United States, of that barrier between them and the markets of the world. The interchange of products between the Atlantic and Pacific States, and the Pacific

States and Europe, must be made by the expensive, dangerous and circuitous route around Cape Horn, twice crossing the equator, at a price per ton of from five to ten dollars, or else submit to the heavy burdens imposed for railroad transportation across the continent.

No wonder that now the industries of the Pacific States languish and decay, and their small population is idle and unoccupied. Population and small capital must seek more favored localities, where lighter freight charges will leave to the producer some margin of profit.

In vain do its people expect and invite to their indeed fertile and extensive shores the most desirable class of emigrants. The great industries of agriculture, mining and lumbering, which constitute the only basis and foundation of genuine prosperity and greatness, can find no markets for their bulky and cheap supplies. The productions of that vast section, however varied and prolific, are consumed by the heavy freight charges of a foreign commerce.

Were the Nicaraugua Canal constructed and opened today by a corporation with the governmental *control* (?) which this bill contemplates and *allows*, the evils of which the country complains would neither be met nor alleviated. The problem of cheap water transportation would be in nowise solved. The only effect would be the shortening of the water route, not for the benefit of the producers and consumers of the country, but for the benefit of the corporation. The question with the corporation will be, how high can we make tolls and attract the most freight? With the producers and consumers, is it cheaper to pay high tolls through the canal or make the long and dangerous voyage around Cape Horn? None of the grand developments which followed governmental improvements of the Mississippi and the Great Lakes will follow corporation management and operation of the Nicaragua Canal. The Maratime Canal Company may be depended upon to put tolls sufficiently low to attract all the freight, and high enough to make the largest profit for themselves.

The bill fixes no rates of toll, nor does it reserve to the Government of the United States the right and power to fix them; on the contrary, it yields up to a corporation consisting of the foreign States of Nicaragua and Costa Rica interested collectively to the extent of $7,500,000 in the stock of the corporation and a few private citizens of the United States, this power, so vital to the industries of this country, and which should be so sacred to its Government. If every director of the corporation were a Government officer, the objection that the bill fixes no rates of toll is absolutely fatal to it, if we have any respect for our principles of government, our policy and traditions."

In respect to the Nicaragua bill before mentioned and now before Congress, Mr. Manson a second time sums up its provisions and faults in the following words:

"1st. The Government, though holding seven tenths ($\frac{7}{10}$) of the stock and guaranteeing the whole bonded indebtedness, is represented on the Board of Directors by a minority of the directors.

2nd. The Government has no control whatever over the contracts of the Maratime Canal Company of Nicaragua, nor over the execution of the work ; it must measure up the work at least as often as every sixty days, and pay to the Maratime Canal Company its guaranteed bonds, whether that work be worth much or little. The Company *may*, under such a bill as this, organize a construction company and let contracts to itself at any figure and to an amount only limited by the extent of the Government's guaranty.

3rd. An examination of the existing treaty between the United States and Nicaragua and the LII Article of the Nicaragua concession to the Company will show that the Company is allowed for the first ten years after the completion of the canal to charge whatsoever rates of toll it may see fit ; and that after the ten years it may divide among its shareholders after paying the necessary sums for "maintenance, operation and administration," a net dividend of 15 per cent. What salaries it will pay under these liberal provisions regarding "administration" and "operation" it is unnecessary to enlarge upon in the light of recent experiences of our government with subsidized railroads.

4th. The Government recognizes in terms by the proposed bill the existence and organization of the Nicaragua Canal Construction Company, an organization which may bear the same relation to the Maratime Canal Company of Nicaragua which the Credit Mobilier, Contract and Finance, Western Development, and Pacific Improvement Companies bore to certain railroads.*

5th. Mr. Menocal's estimate of the cost of the entire work, and his plans and location recommended to the Government of the United States have been adopted almost in toto by the Corporation, including a contingency allowance of 25 per cent., is $64,036,197. There is no good reason why the Government should resort to any method whereby the cost shall be $100,000,000.

6th. The hitherto almost invariably corrupting influence upon the Government and its officers of this class of legislation.

7th. The proposed bill allows two foreign countries — Nicaragua and Costa Rica—and the private stockholders of the Company to fix the tolls which shall be paid on the business of the canal.

8th. The Government of the United States may be called upon to defend these unfair exactions, extending through a period of 198 years, if not upon the commerce of its own people, upon foreign commerce, involving the United States in an unjust war with foreign countries.

9th. The basis upon which, as a financial enterprise, the Company invites subscriptions to its stock, is $2.50 per registered ton for

*In answer to a question by Senator Dolph, Mr. Hitchcock, the President of the Maratime Canal Company, stated that all the stockholders of the Maratime Company are members of the Construction Company.—*Congressional Record*, February 22nd, 1891, page 3265, where this answer is read as part of Mr. Hitchcock's testimony.

vessels passing through the canal. Could the important industries of the Pacific States, engaged as their people are and wish to be in mining, lumbering, agriculture, fisheries, canneries, etc., etc., enter the markets of the world with the bulky and cheap supplies of this class of merchandise, and yield at this rate of toll any profit to the producer? It is perfectly clear that their export will exceed their import tonnage, for they will ship bulky and cheap articles, and import as a rule, a much lighter class of merchandise. Thus the Pacific Coast producer will have to pay tolls both ways, though his productions pass through the canal but once. The cost of passing through the canal is the same, whether the vessel be loaded or unloaded. With what hope of successful competition will the Pacific Coast farmer expect to enter the markets of the world, when even the farmer of Manitoba, Assinobia and the valleys of the Saskatchewan can, through the cheap water communication from the western end of Lake Superior, the Sault Ste. Marie, the Welland and St. Lawrence Canals and the St. Lawrence River, reach the Canadian ports of Montreal and Quebec, at a charge, embracing all canal and river tolls and dues, of only *two* (2) *cents per ton on grain.*

10th. The bill does not anywhere fix the rates of toll; this is left to Nicaragua, Costa Rica and the private stockholders, who shall, under the concessions, control this enterprise for two terms of ninety nine (99) years each."

Mr. Manson's essay closes with the following words, which will find endorsement on the part of every one who wants to see the Nicaragua Canal made as an enterprise for the public good:

"The United States can never, with any respect for itself or regard for its people, do otherwise than pay the present incorporation fairly for what work it has already done under concessions from Nicaragua and Costa Rica. It should repeal the charter of the incorporation under Sec. 8 of the Act of February 20, 1889, incorporating the Maratime Canal Company of Nicaragua, which reserves to the Government the power of repeal. And it should immediately arrange by treaty with Nicaragua (and with Costa Rica, if necessary) on the same general basis of the concessions to the Company, though modified in certain important particulars, for the construction and *genuine control* of the Canal by the Government of the United States. When thus constructed and operated and opened to commerce, the Ship Canal at Nicaragua will prove to be the 'crowning glory of the age.'"

There is no sentiment in the country that would deprive the present Construction Company of any money spent or work done. They should be paid, fairly paid for all, including a reasonable sum for the concessions fron Nicaragua and Costa Rica, although these latter are possibly of no value whatever to the Government, which should be able to negotiate with these countries to a better advantage than a private company can.

POWDER EXPLOSION.

The Giant Powder Works plant, near West Berkeley, a suburban place on the North Eastern Coast of the bay, about eight miles from San Francisco, was blown up at nine o'clock A. M. on the ninth of July, and it is believed to be the most extensive explosion of the kind that has ever happened.

Being situated on a spit of land projecting out into the bay there was a free course for air disturbance to the City, and other surroundings on the southern and western side of the bay, and windows were crushed for a distance of ten miles where no elevated land intervened. The air disturbance followed channels where the physical formation permitted horizontal flow, and even streets in the city seemed to have guided the lines of greatest effect.

The loss of life was happily very slight compared with what might be expected, most of the people after the first explosion making their way to some distance so the force of the explosion passed over them. The number reported killed is less than ten, of which all but three were Chinamen. It requires only a short time, and a little distance, to get without the active circle of explosions, which act upward at an angle of ten to twenty degrees, principally because of the material being partially below the surface of the ground, as in the case of magazines, also because the first effect is to excavate a pit the walls of which act as directing angles.

The amount of material finished and in process is not known, but was certainly not less than one hundred tons, some reports say several hundred tons, a quantity that should never be stored near a thickly settled district, near to a city, and almost alongside of a railway on which there is a crowded service. The legal restrictions, or rather the exercise of restrictions, in respect to such a manufacture does not seem to have any part in the matter. There is no inspection of powder works, consequently no control over the situation, character of the buildings and apparatus, or the kind of men employed, and we have the natural result of periodical explosions. The competition between manufacturers and the low price of explosives leads to the construction of unsuitable buildings with no ramparts, set near together, and the employment of a low-class of labor. The result is disaster. There are powder works in all countries, but destructive explosions such as happen here, do not occur.

We visited, some years ago, the powder works at Dartmouth, in England, where a vast works has been conducted for a century past without exploding a single pound of any substance, and there is little or no danger of such a thing. The works are guarded in various ways. There is thick growth of large trees all over the grounds which are very extensive. The different buildings are surrounded by earth walls, and all conveyance is by boats floated in ditches which extend all over the grounds. No iron, not even a nail, is used in constructing the boats, and no wheel vehicle of any kind is permitted within the grounds.

The laws in England require a license for the manufacture of explosives, and provide for official inspection not only of the situation and plans but the conduct of such works. We imagine the same regulations exist in all European countries, and do not impose any onerous or unreasonable restriction on the manufacture.

The broken, hilly country on nearly all sides of San Francisco furnishes secure situations for such factories not distant from the City, and if the slight per cent. of extra cost by reason of occupying safe positions were added to the product, no one would object. It is an extensive and important manufacture here, and a necessary one that should not be discouraged, but its removal to a safe distance is not only reasonable but just to those who own property and live in the vicinity of the works, also those who are compelled to travel near to them.

If anyone will consider the extensive and even meddling laws and regulations that apply to the navigation of rivers and lakes, and the total lack of them in respect to some other kind of public danger, they will be amazed at the circumstance.

WATER WHEELS AT NIAGARA.

It is reported that the Niagara Cataract Construction Company have ordered from Messrs. Foesch & Ficcard, a Swiss firm at Geneva, two turbine water wheels of 5,000 horse power each, which if true admits of remark in several ways.

In the first place, why have not our Eastern contemporaries announced this fact? It is one of some importance, and comes back as news from Europe; secondly, why order wheels in Europe at all? There is not an engineering works of any standing in America that would not undertake the construction of Girard wheels, such as we suppose these to be, and would construct them in strict accordance with well-known data and rules that apply to wheels of the kind.

There is perhaps no class of water wheels so well understood or "worked out" as impulse turbines. They are made with great uniformity in France, England, Germany, Switzerland and Hungary, and were the subject of several articles published in this Journal a year or more ago, and discussed in connection with this Niagara scheme. We also pointed out, as has since been proven, that the London Commission on methods for the Niagara plant would consider only impulse water wheels, and that no firm in this Country, except the Pelton Water Wheel Company in this City, were prepared to tender in competition with foreign makers.

This turned out almost precisely as predicted. No other tender from this country had recognition, or at least no other award was made for plans presented from the United States. Central discharge or inward flow turbines of the pressure type, almost the only kind made in this country, are not adapted to the head and other circumstances at Niagara, but the California impulse wheels are eminently suited for the work, and there is an inference at least that our Eastern friends are employing a policy sometimes called the "dog in the manger" one. They cannot make the wheels, and will not let others do so, at least will not permit anyone in California to construct them.

The amount of information respecting water wheels, among engineers even, is very limited. We have been astonished many times in presenting the subject of open or impulse wheels of the Girard type, that even water wheel makers and dealers knew nothing whatever of them.

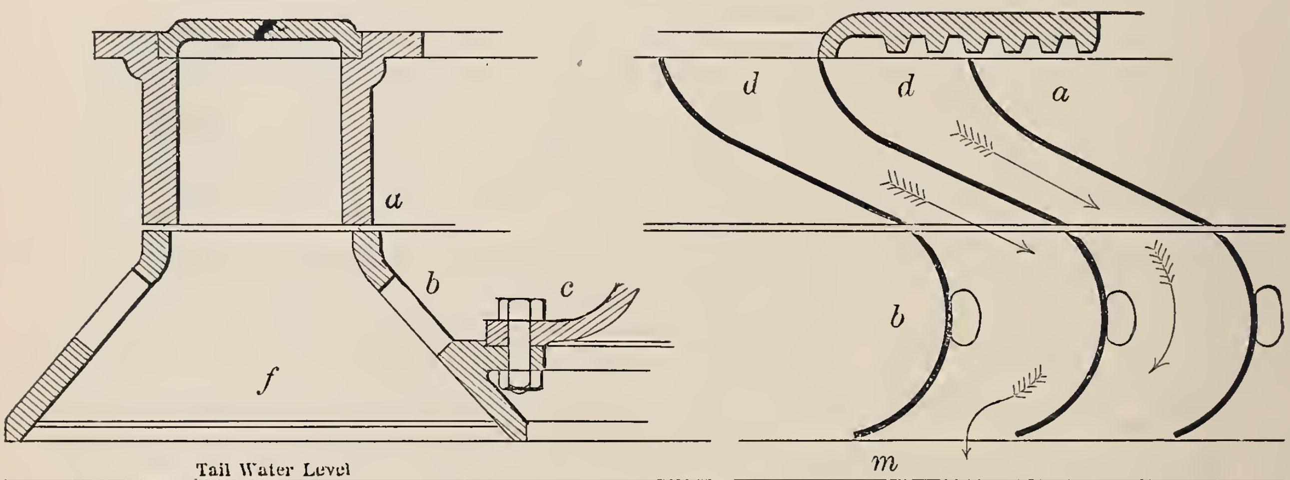
None have been made in this country except in California, or on plans furnished from here; but now that nearly a year has elapsed since the London Niagara Commission met, and the subject has been before the country, there is, as before said, no difficulty in having impulse wheels constructed from various published plans by European makers, even if the California wheels were shut out for geographical or any other reason.

We are sorry to say there has been very little to admire, and nothing at all creditable to engineering skill in the whole of this Niagara matter, in so far as the power plants, and the order for water wheels of 10,000 horse power in Geneva is the crowning absurdity in the case. The character of the wheels to be furnished is not explained any further than the name "turbine," which in

Europe is commonly applied to open or impulse wheels as well as the pressure type ; but supposing, as before assumed, they are to be of the Girard type, the following diagram and explanation, from *The Manual of Machine Construction*, will show their simplicity :

"The Girard type of wheels corresponds in its main features to the Jonval, but acts wholly from impact of the water instead of pressure, consequently can have any number of jets or inlets, and use a large or small quantity of water without interfering with the efficiency and working conditions.

The diagram shows the form of the issues and vanes for a horizontal wheel.



GIRARD IMPULSE WATER WHEEL.

In the drawing *a* is the fixed part, and *b* the wheel. The latter is supported by the flange *c* connecting with the shaft. The inlet nozzles *d d* are arranged so that one or more can be uncovered by the gate on top. The wheel is widened toward the discharge, as shown at *f*, in the section, to permit a free escape of the water.

The Girard wheels attain a high efficiency, and are especially adapted for high heads or pressures. They operate well under a head of 400 feet, and can be adapted for low heads by increasing the number of issues accordingly."

If not Girard, but Fourneyron or Jonval wheels are to be furnished from Geneva, then there is the answer that Fourneyron wheels made in this country thirty years ago are as fine examples as can be referred to. We allude to the Boyden wheels at Lowell, Mass. If Jonval wheels, the practice of Mr. E. Geyelin, of Philadelphia, is not excelled in Switzerland or elsewhere, and there was no need of going to Geneva for wheels of any kind.

A LARGE HYDRAULIC RAM.

Mr. Washington Jones, who was for nearly a quarter of a century the consulting engineer of the I. P. Morris works, in Philadelphia, was among the members of the Mechanical Engineers who visited this Coast in May. In conversation with him he mentioned a large hydraulic ram constructed at the Morris works in 1878, and at the request of the Editor of this Journal, sent the following particulars relating to the apparatus, which to that time was the largest that had been made in this country, and except those employed at the Mount Cenis Tunnel, the largest made in any country, of which there is any published account. The drawing shows a vertical section through the operating parts of the ram on a scale of 1 = 24.

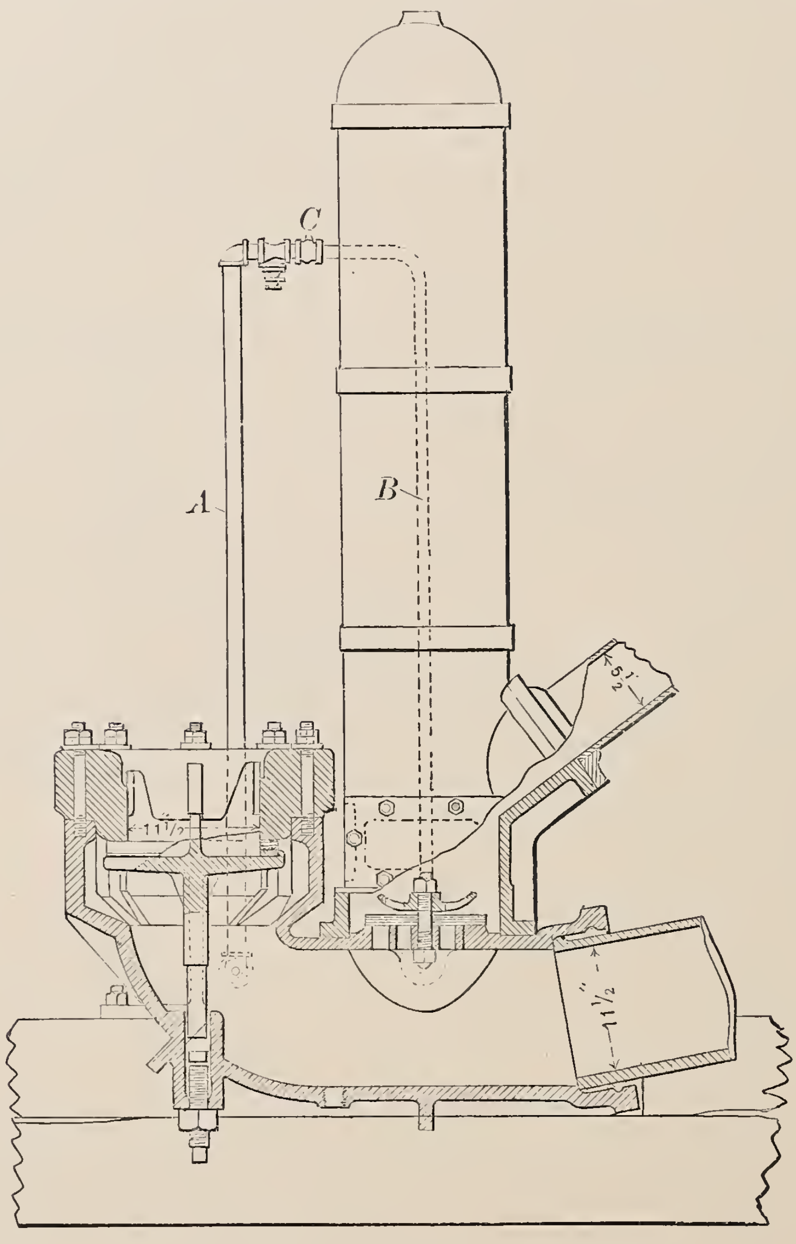
The following extract is from a description by Mr. Jones in the Journal of the Franklin Institute, Vol. CVI, No. 633:

"Recently, the I. P. Morris Company made at their Port Richmond iron works, to be used for the purpose of irrigating the higher lands of a coffee plantation in South America, a hydraulic ram, whose capacity is greater than that of any other known to them. The following data were furnished by the purchaser with his order. As will be noticed, they cover the most important points, except the quantity of water available, which, therefore, was assumed to be ample:

Height of fall	9 ft.	10	in.
Elevation of reservoir	63 "	10	"
Diameter of inlet-pipe		11½	"
Length " "	52 "	4	"
Diameter of discharge pipe		5½	"
Length " " "	127 "	8	"

The capacity of the air-vessel was increased to 5½ cu. ft., as the additional expense of the material was amply compensated by the known advantage of a large air cushion, in partially relieving this type of machine from the violent shocks inseparable from its action. The minor details, and their disposition, were determined upon by the constructors, after consideration and information obtained by reference to Crecy, London *Engineer*, and Spon's "Dictionary of Engineering," wherein were found descriptions of several, which, though of small capacity, were of assistance in forming a conclusion. The results were embodied in the machine, of which the following is a description. A reference to the cut will make the construction more readily understood.

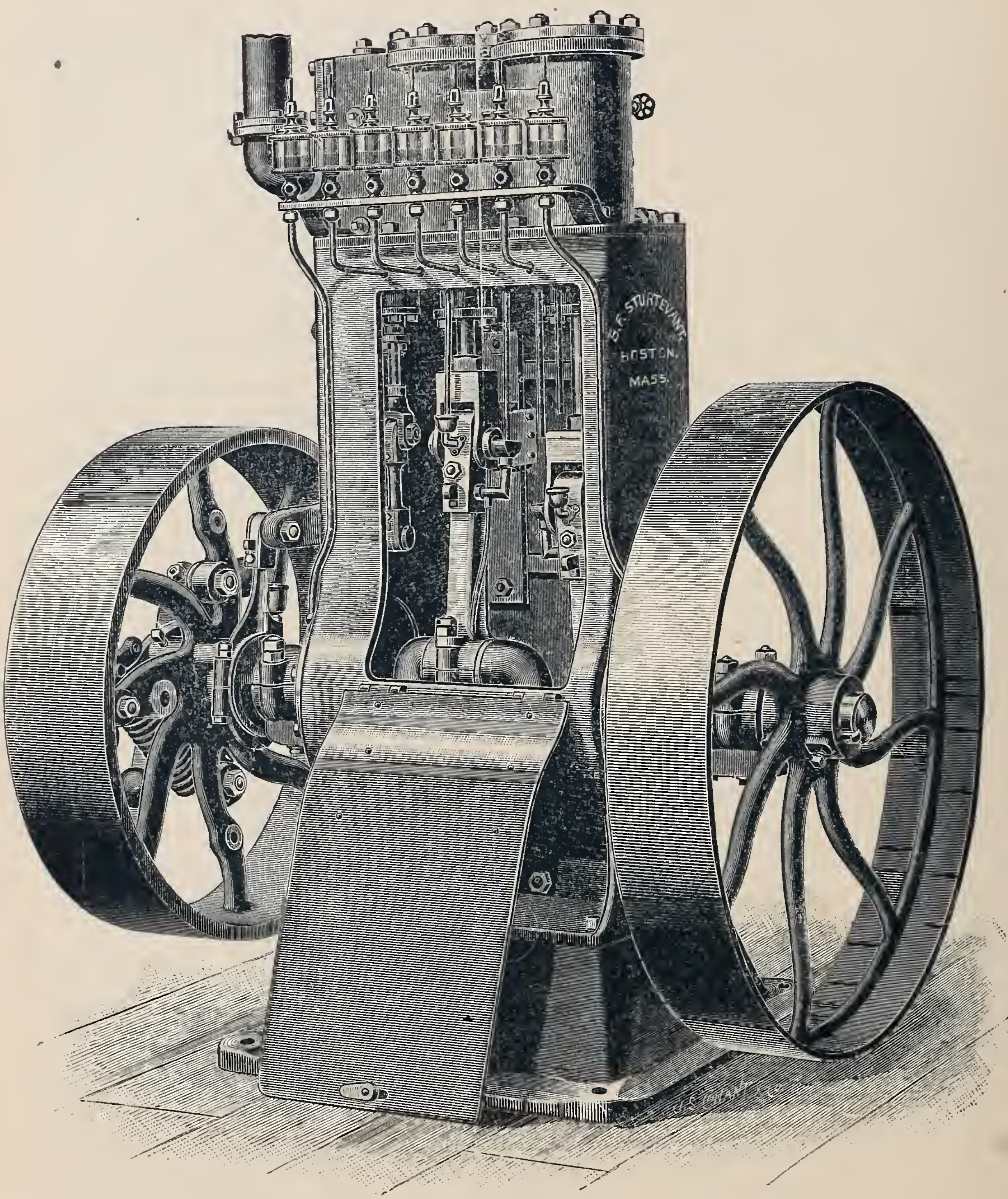
The body of the ram is a cylindrical pipe 11½ inches bore and 1⅛ inches thick, strengthened with flanges. It curves upwards, at the rear or discharge end, until the axis or bore becomes vertical, when the bore is enlarged to 19½ inches, so as to form a chamber for the waste-valve. Several vertical ribs join the flange, provided for the valve-seat at the top of the chamber, with the main body of the ram. About midway the length of the body is the seat for the water-valve and the air-vessel. A horizontal flange on each side of



TWELVE-INCH HYDRAULIC RAM.

WASHINGTON JONES, M. E., PHILADELPHIA, PA.

body, strongly ribbed, serves to hold the machine to timbers which rest upon stone foundations. Six bolts pass through all, with keys and plates at lower ends. The water valve is of gum, and sets upon a grating cast on the body of ram, and is held in position by a stud carrying a guard. This valve is encased by the air-vessel and access to it is had through a door. The body of the waste-valve is of cast iron, strongly ribbed, and is guided at its upper end, by wings sliding within the bore of the valve seat, and at its lower end by a stem, working in a hole, bored in the body of the ram. This hole is fitted at its lower end, with a long tap bolt, which is used to adjust the drop of the valve and the number of beats per minute at such a point, found by trial, where best efficiency of the ram is obtained. A piece of gum, interposed between the ends of stem and tap-bolt serves to soften the blow of the descending valve. The face of waste-valve is a ring of wrought iron, riveted to the valve with three thicknesses of heavy sole-leather between them, so as to give some elasticity, and thereby diminish the shocks given by the valve closing. The waste-valve seat it of cast iron, made heavy (about five times the weight of the valve), and firmly bolted to the body of the ram. The supply is carried through cast iron pipes having socket joints, and their thickness diminishes from 1⅛ inches at the junction with the ram, to ⅝ inch at the upper end. The ascension-pipe is welded wrought iron tube, 5½ inches diameter, joined by flanges. The apparatus for supplying air to the air-vessel is essentially that designed by Mr. Bolée (see Spon's "Dictionary of Engineering," article "Hydraulic Machines," folio 1972), with a modification of the "snifting-valve," which compels all the air admitted through it to enter the air-vessel; or, if in excess, as in this case provided so, the surplus escapes between the under side of valve-seat and the top of the screw-plug, on which the valve is mounted, through an opening adjustable by means of a screw shank of the valve seat. The supply air passes upwards through the hollow shank, then outwards, through holes, into the space below the valve-seat; the valve-seat is perforated with several holes, through which the air rises and lifts the valve. When the valve closes, the return of any air is prevented, but if the seat be raised from the top of the plug, a portion of it, more or less, as desired, passes between them and escapes. The valve is placed high enough to be above floods, and its operation is as follows: The tube, *A*, is of 1-inch gas pipe, and it rises, from the point of its attachment to body of ram, to a suitable height, and carries the snifting-valve and a check-valve; it is then joined by a ½ inch gas-pipe *B*, which descends and meets a check-valve, attached to the ram, immediately under the air-vessel. When the waste-valve opens, the water contained in the pipe *A*, falls, and produces a vacuum, when the air enters, through the snifting-valve, into pipe *A*,. When the stroke recurs and waste-valve closes, the water rises in pipe *A*, and displaces the air, which under pressure, opens the check-valve *C*, whence it passes through pipe *B* and check-valve *D*, into body of ram, and ascends into the air-vessel. This occurs each stroke, so that the supply of air is continuous. Any surplus is discharged by the modification before described."



ENCASED DOUBLE HIGH-SPEED ENGINE.

THE B. F. STURTEVANT CO., BOSTON, MASS.

The drawing above, furnished by the makers at Boston, is an example in machine design lying outside the routine of modern practice and with some commendable points of novelty. It is a study, in fact. It may be noticed there are several peculiarities of the marine type of engines—the broad slipper guides and oiling apparatus, for example. The disposition of the framing from the crank shaft upward, would, if laid horizontally, be not very far from good horizontal practice, while the general arrangement is that of common vertical engines, but capable of being enclosed without rendering the parts inaccessible.

It is a "composite" design, intended for high speed, and so far as can be seen from the drawing is more carefully worked out than anything of the kind we have seen for a long time. The enclosure of the reciprocating parts, or of the whole engine, as it may be called, is a feature of our time, or of recent times, that is a very desirable one if the work is well made and accessible, as seems to be the case here.

The cylinders and piston valve chamber form a symmetrical row on top of the main frame, the outboard covers being free and all of the cylinders removable without difficulty. Anyone who will follow back through twenty years past and note the tendency of practice, can see designs converging to a kind of standard in so far as framing and some other features, and with what are undeniable advances. Vagaries will come in as we go along. Two of these, we consider, are what is called a Corliss frame set up on "legs," so as to neutralize the advantages of a foundation, and the other is the making of vertical frames in the form of an Egyptian urn or modern flower vase, with a "waist" just above the foundation or base portion. This last is a repulsive kind of feature to the eye and a violation of the laws and rules applicable to projecting standards or brackets. A tree, one of Nature's designs, which are always correct, is not cut away with a diminished section just where the greatest rigidity is required.

Structures or parts supported from one end, whether vertical or horizontal, come within a class called standards if vertical, or brackets if horizontal; neither term being relevant or correct, perhaps, but there is no mistake respecting their proper form and section for both strength and appearance. Of all things, a "waist" in a machine standard is the worst.

FIG. 1.

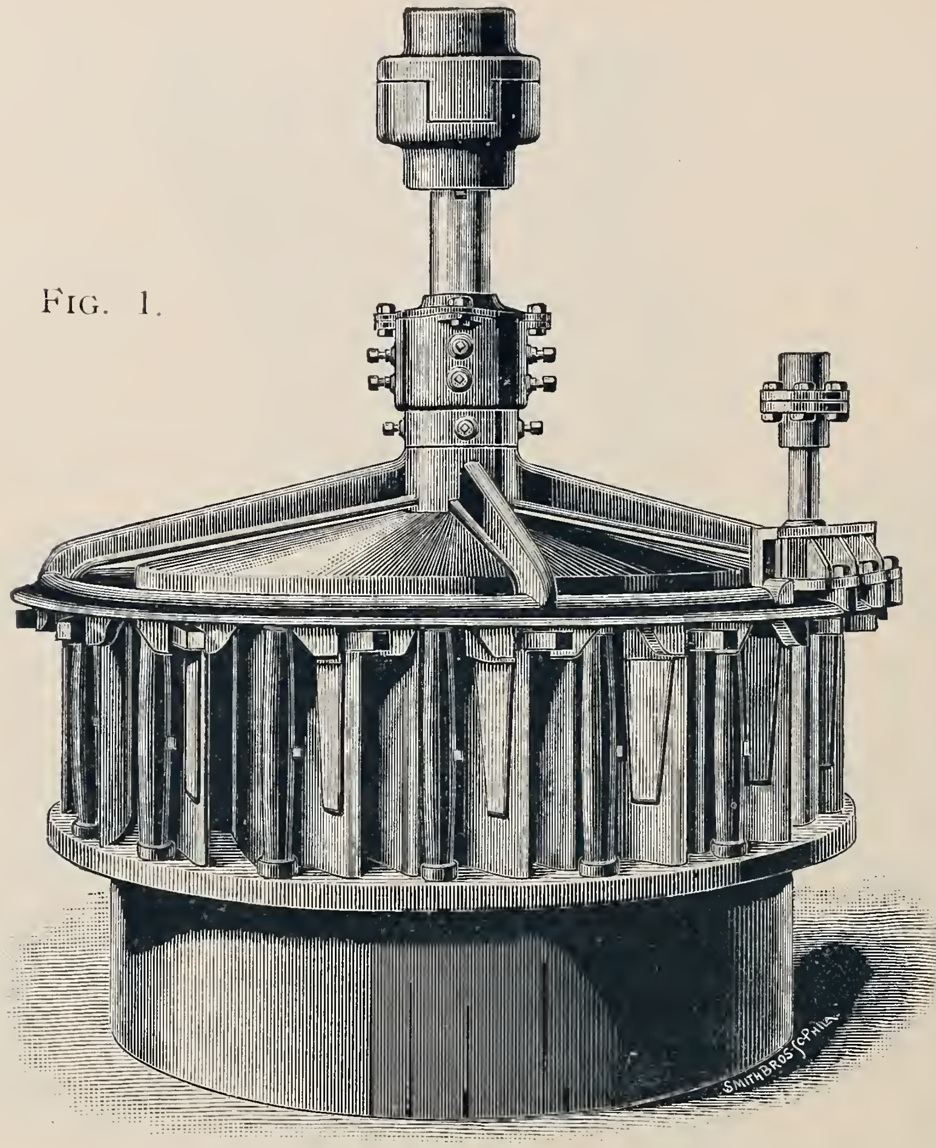
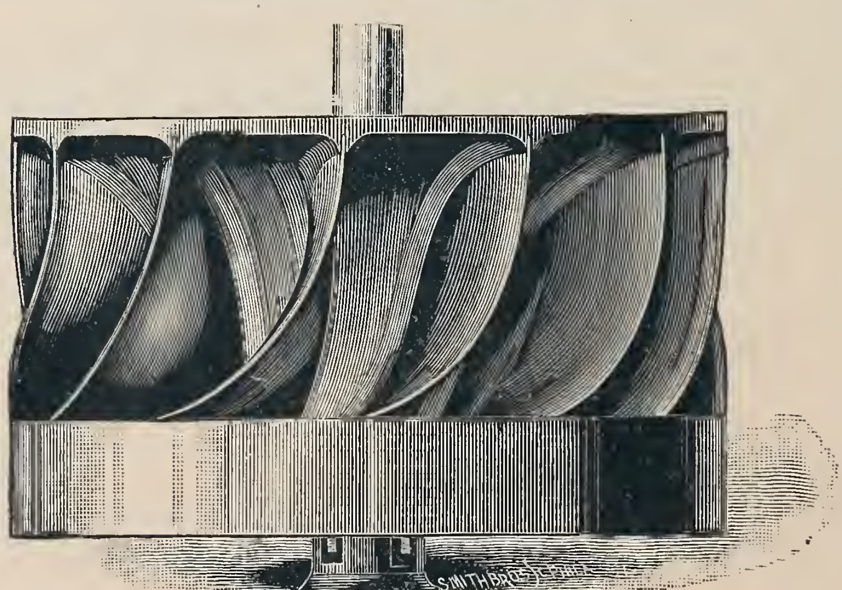


FIG. 2.



INWARD FLOW TURBINE WATER WHEELS.

S. MORGAN SMITH, YORK, PA.

Fig. 3.

SOME REMARKS ON TURBINES.

The drawings herewith have been kindly furnished by Mr. S. Morgan Smith, a maker of turbine water wheels and mill gearing, at York, Pa., and are intended to illustrate some very good features in turbine practice of the inward flow type, and also the application of a principle in water wheel construction that has met with little recognition at this time.

Referring first to Mr. Smith's wheels, Fig. 1 shows an elevation of a complete wheel, Fig. 2 the inner or revolving part, and Fig. 3 illustrates the method of constructing the chutes or inlets, commonly called collectively the "gate" for controlling the volume of water discharged on the wheel, also the form of the vanes at the top of the wheel.

In respect to construction, it may be noticed that the inlet orifices or chutes are formed by a series of pivoted levers, having no joints or fittings except the pivots on which they swing. Their form and movement is such that the shape of the throat is almost completely preserved, or is even improved by contraction, as is shown by experiments, in which the efficiency of the wheels fell off only twelve per cent. from whole to half gate, a result that exceeds any other case of which we have any knowledge.

The main feature of construction, or the one that will most recommend itself, is the absence of links, bolts, or, as we may say, all contrivances for holding and adjusting the gates. In Fig. 3, it will be seen that the gate vanes or jams project out beyond the wheel cover, terminating in plain arms or handles K. On the top of the wheel is a crab plate having downward, projecting teeth or lugs that engage these handles K, like the teeth of a wheel, so that all are moved together uniformly and exactly, without any chance of breaking or derangement. The claw ring or plate is turned by a tooth pinion and sector in the usual manner.

Coming next to the vanes and their form it will be seen that at the top of the wheel they are curved "in the direction of rotation," the opposite of common practice, and this form is changed to nearly radial faces below the center of the wheel, then changes to a curve in the opposite direction at the bottom. This form of turbine vanes as far as we know, was first introduced by the late Theodore Risdon, of Mount Holly, New Jersey, and marked a departure in water wheel practice that produced some very unexpected results at the tests made at Philadelphia, during the Centennial Exhibition in 1876.

No other wheels, whether of the radial, downward, or inward flow type, so far as known, have ever been constructed on this principle, except by Mr. Risdon and Mr. Smith, and no other wheels of the inward flow type have given so high a percentage of useful effect. The reason of this high efficiency, reaching in some cases 90 per cent., is not far to seek, existing evidently in the form of the vanes and the convex faces presented to the entering water.

It is not within the limits of this article to deal with the geometry and hydraulics involved in this form of the vanes, and the effect produced thereby. This is a problem of great complexity if resolvable at all by computation, but what we want to point out is that in the case of the present water wheel or any other, including even tangential wheels, the vane surfaces are more nearly normal to the line of impact when they present a convex surface instead of a concave one to the entering water. This is, of course, easily demonstrated by diagrams, and will furnish an interesting problem which we commend to our readers who have the skill to lay down and resolve such diagrams.

This proposition is somewhat revolutionary in the fact, as before said, all water wheels are made on the opposite method with an idea of confining or concentrating the water by concave faces. In the case of tangential wheels with the necessary object of reversing the course of the water in one plane of discharge, but in the case of pressure turbines with no apparent object whatever.

By examining Fig. 3, showing a plan view of one of Mr. Smith's wheels, the method of presenting convex faces to the water is clearly shown. In other words, the vanes curve forward instead of backward, and while a right line through the axis of the inlet orifices or chutes may not indicate a normal impingement on the vane faces, except at one point, there must be taken into account the curvature of the leading or forward faces of the inlet, which are curved so as to discharge the water in some degree toward the center of the wheel.

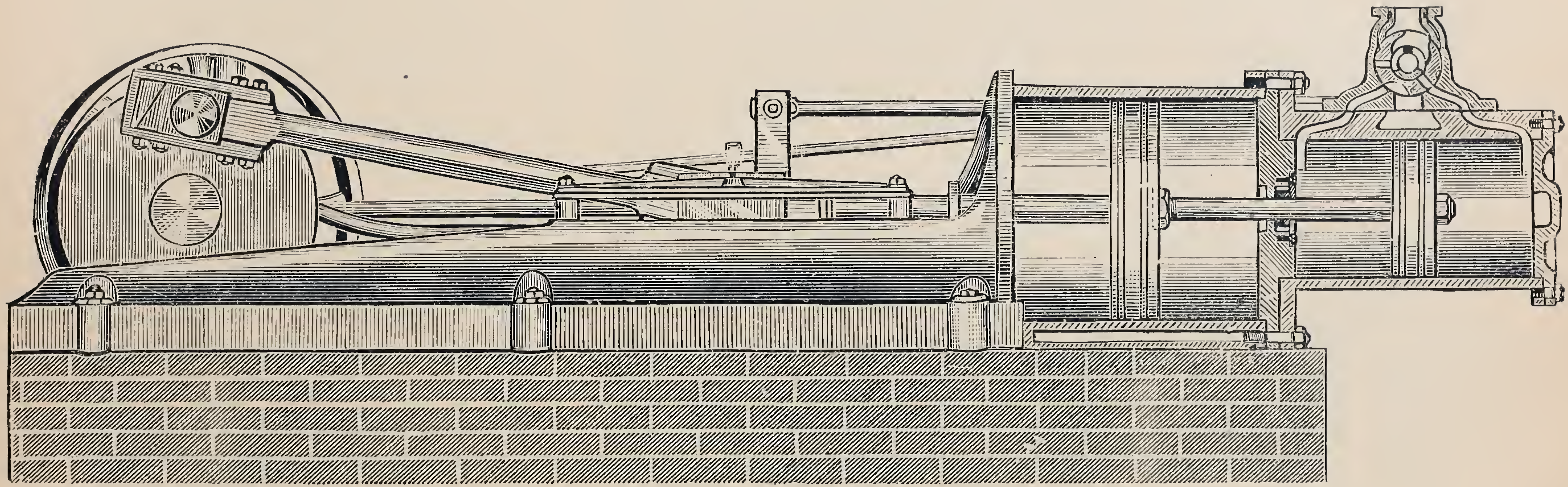
The efficiency attained by the American inward discharge, turbine wheels, a type developed in this country, is perhaps the most extraordinary fact in the whole art from the beginning. The cost of construction and also of maintenance has been wonderfully reduced, and rotative speed increased so as to avoid multiplying gearing, without any sacrifice of economy or efficiency.

The water wheels, illustrated in this article, are represented on this Coast by the Pelton Water Wheel Company of this City.

COMMUNICATION.

To the Editor of Industry.—The "new" method of treating gypsum with the root of *althæa officinalis*, described on page 548 of your last issue, is an invention of C. Puscher, Nuremberg, Germany. It was made or published in 1869, that is, at a time when all German chemists were astir to earn a prize offered by the Prussian Government for discovering a method of making plaster casts so that they could be cleaned by washing with soap and water without getting spoiled. Puscher's process was a failure in that regard, as were all other propositions offered. It will be found fully described in *Dingler's Journal*, vol. 191, p. 344, or in *Wagner's* "*Yahresbericht*, 1869, p. 373. The new process starts on its second international trip through the technical literature with almost the identical baggage of the first journey in figures and promises.

San Francisco, July 20th, 1892. I. Gutzkow.



COMPOUND AUTOMATIC CUT-OFF ENGINE.

W. H. OHMEN, SAN FRANCISCO.

COMPOUND AUTOMATIC CUT-OFF ENGINE.

W. H. OHMEN, SAN FRANCISCO.

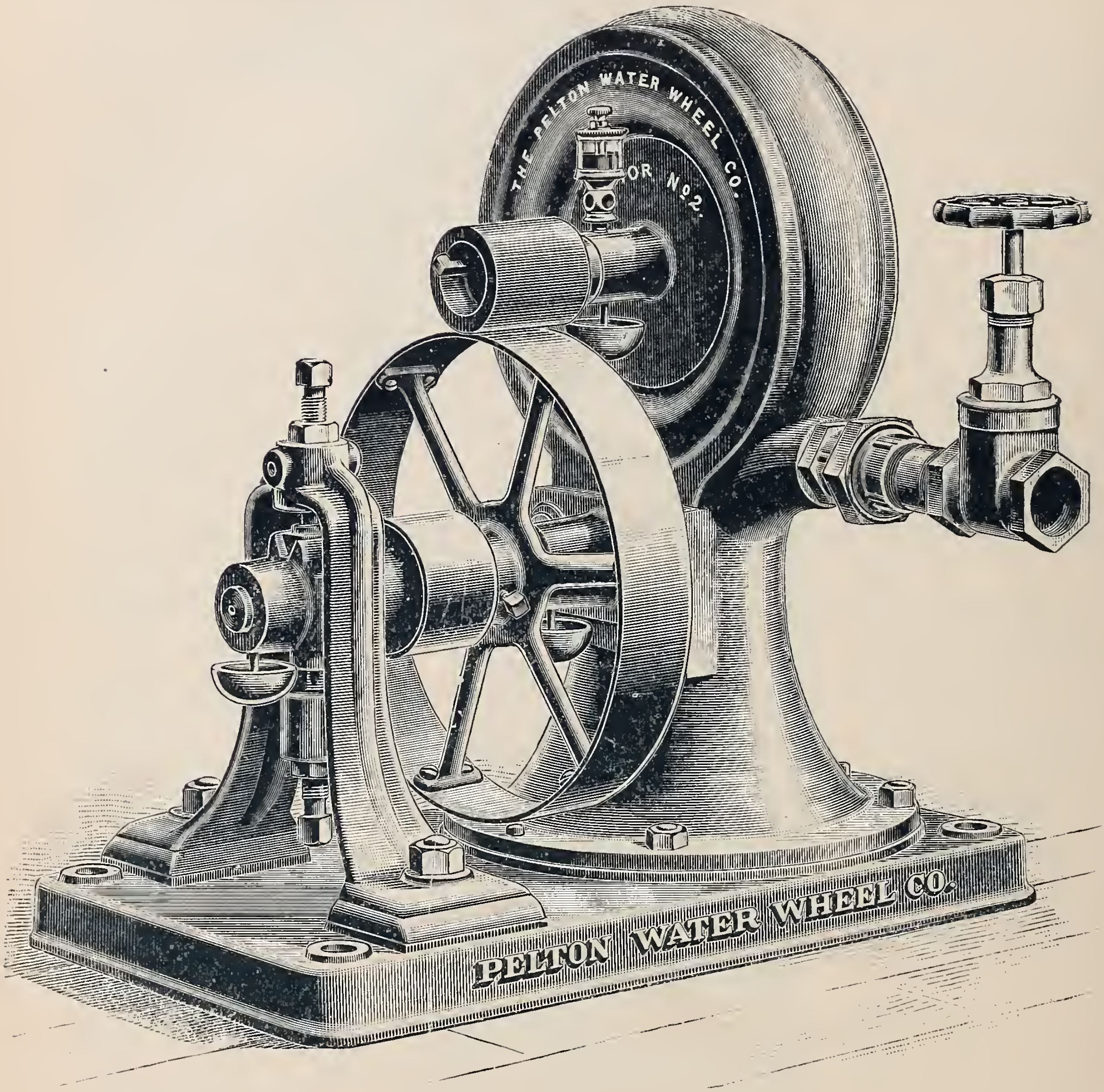
The engine shown on the opposite page is one of "evolution," and the result, or refinement, of numerous improvements by the maker, who for more than a dozen years has continued in a progressive way to improve his high speed engines.

The design, although shown in a broken view, has, as can be seen, many points of novelty. The valves on the initial cylinder are of the oscillating type, and those on the low pressure, plain slides. The valve gearing and all handling parts are clear and accessible, while the disposition of metal in the framing, and the general symmetry of the engine, show what is called careful working out.

Mr. Ohmen has in various cases reached a phenomenal efficiency with these engines, and the industry is one that we may well be proud of here in San Francisco.

Engines of the same general type are made from 20 to 200-horse power, and are guaranteed to develop with a given weight of steam the maximum amount of power possible under any given conditions of use. There has been in several cases recently, running tests made, but the data has not yet been put in proper form for publication. In one case the fuel consumption is 2¾ pounds of coal per hour, without condensing apparatus.

There has been recently applied in England a pneumatic apparatus for raising and conveying grain by the induction process. Compressed air at a pressure of 40 pounds per inch is applied, the same as in the case of water raising injectors or "ejectors," and it is claimed that 100 tons an hour can be raised 40 feet high at an expense of four cents a bushel, or that 50 tons an hour can be raised 40 feet with 560 pounds of coal, which is not a very cheap rate when fuel, investment, attendance and erecting or connecting are considered. There have been a good many experiments with fans and conducting tubes in this country, in which the grain passes through the fans, and some in which it does not, and as these are more simple methods, the failure, if they are a failure, must be for want of pressure or strength of the current. The injection method would overcome this, but at a great loss of power. The idea is worth considering, however, where grain is handled in bulk, as is done all over this country except in California.



HYDRAULIC MOTOR FOR SMALL POWERS.

PELTON WATER WHEEL CO.—SAN FRANCISCO AND NEW YORK.

The above engraving, which by the way is an especially fine one, shows a jet motor made by the Pelton Water Wheel Company, such as is furnished for small powers, the first mover being a friction gearing, reducing the motion about six times. The second mover is the small pulley on the countershaft.

The design is neat, simple, cheap, and, as we have many times remarked, the wonder is that such wheels are not as plentiful as sewing machines wherever water under pressure is available. There are, on dairy and other ranches in this State, hundreds of places where a small amount of power could, in this way, be provided at a trifling expense, while in all cities and towns having a water supply system, motors of the kind can be employed in every factory, store, or even every household.

The Company, for a long time, neglected this manufacture of small motors, but have now, by the higher efficiency of their wheels, built up a large trade over the older kinds, both here and at the East.

HIGH-SPEED CORLISS ENGINES.

[Communication.]

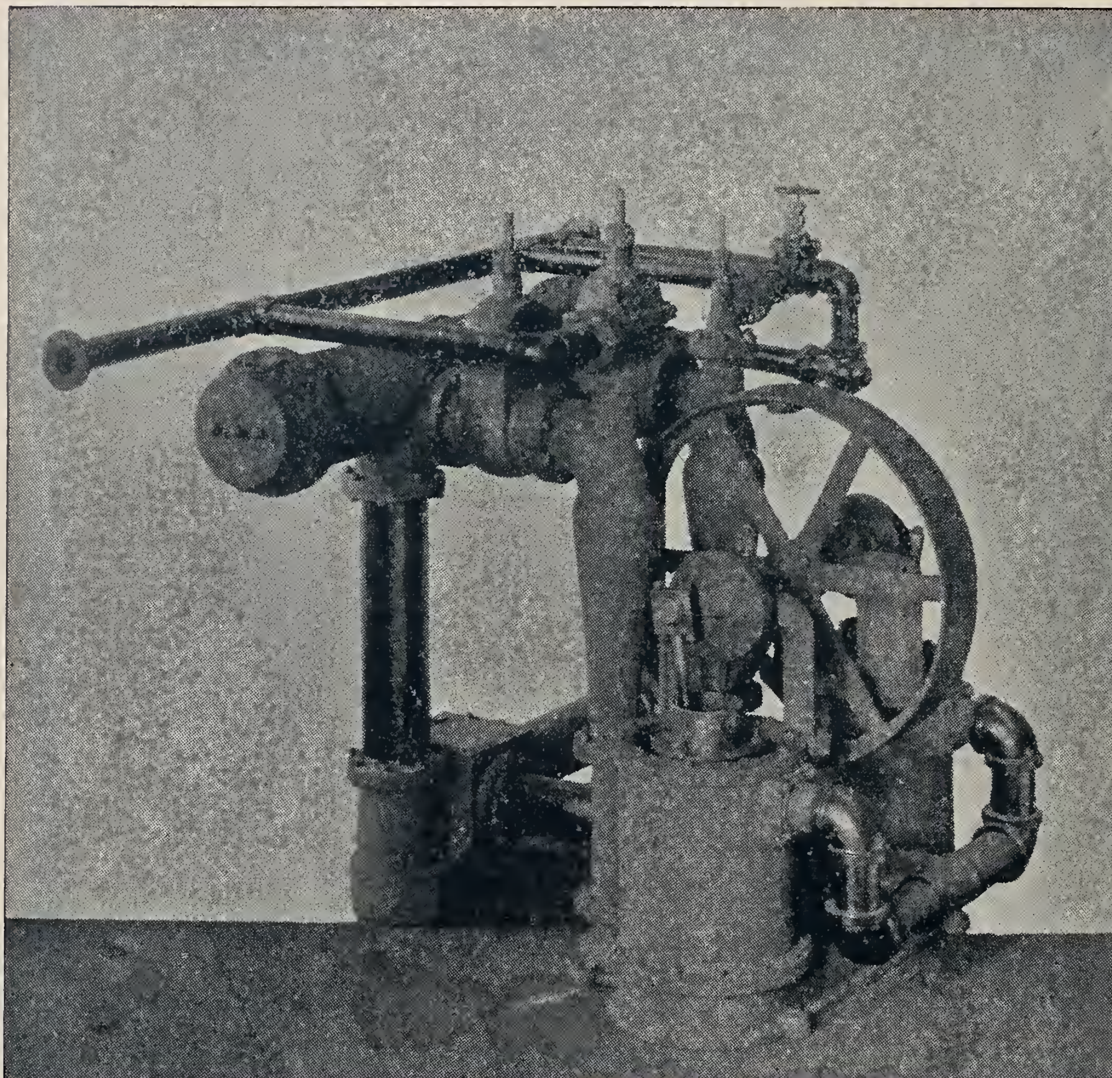
To The Editor of Industry:

Sir: In the July number of Industry under the title of a 'New Engine Valve Gearing,' in which Mr. Hoadley, of the California Engineering Co., presents a description of the new Wheelock valve gear, which he represents, I note in connection with the speed at which the new valves can be operated, the statement that in obtaining a speed of 150 revolutions per minute it exceeds that of any other liberating valve gear, the highest he having known is 102.

Mr. Hoadley will, no doubt, be glad to be informed as to fact, and Prof. Gale, in the discussion following Mr. Hoadley's paper, says 'he remembers seeing the statement some time ago of a Corliss engine in the East running at the rate of 125 revolutions per minute.' I do not know to what engine Prof. Gale refers, but at the Trenton Iron Works, with which I am connected, we have a Corliss engine built by the late Geo. H. Corliss, of Providence, and now in constant operation day and night since 1877, driving a Belgian wire-rod train, that runs 165 to 170 revolutions per minute. The engine is essentially the regular Corliss engines of 20 inch bore, of cylinder 42 inch stroke. The piston speed is from 1155 to 1190 feet per minute, the former being the usual regular speed. The fact of an engine of this type running for 18 hours per day over a period of 12 years actual, though 15 years is the full, period in which the engine has been in use is, at the high speed stated, worthy of record, and I may say, considering the severe work imposed on the engine due to rolling steel wire rods from a 4 × 4 inch billet down to a No. 4½ wire gauge at a single heat, the wear and tear is remarkably light, as the engine is in good order today and doing its work. During the past year the steam pressure has been increased from 80 to 100 pounds initial, and the indicated horse power has at times reached 500, and suddenly dropping to 200, and even to only 50 in less than 15 seconds, gives good evidence of what the Corliss gear is capable of, and the end may not have been yet reached as the dash-pot pistons drop without a miss and to the full point of closure. Hoping this brief statement may prove interesting to the readers of Industry, as well as instructive to those in search of facts in the domain of steam engineering. I am, yours truly,

Trenton, July 8, 1892. S. S. Webber.

Asst. Manager, The Trenton Iron Co.



DOUBLE JET CONDENSER AND AIR PUMPS.

BYRON JACKSON SAN FRANCISCO.

In our last issue was published an engraving and description of a large pumping plant for reclamation purposes, and mention made of an independent air pump and condenser to accompany the same.

The engraving above has been prepared to illustrate this machinery. The waste steam from the engine is discharged into the drum receiver at the top where the pulsations are to some extent destroyed, and the steam passes on through the two large stop valves to the tapered condensing chambers behind the pumps. In these chambers are spray valves operated by the small stems seen on the top, condensing water entering by the smaller pipes around the top of the machine.

The condensed steam and water falls into the hollow sole plate, and is discharged by the bucket pipes pumps shown in front. The discharged water passes through the pipe leading from the front of the pump to the rear of the machine, and up through a check valve in the rectangular chamber, or box, at the rear, and is discharged through the horizontal pipe leading from this box chamber.

If the vacuum should fail from any cause, or the main valves at the top are closed, then this check valve opens automatically, and the exhaust steam passes off through the horizontal waste pipe before mentioned.

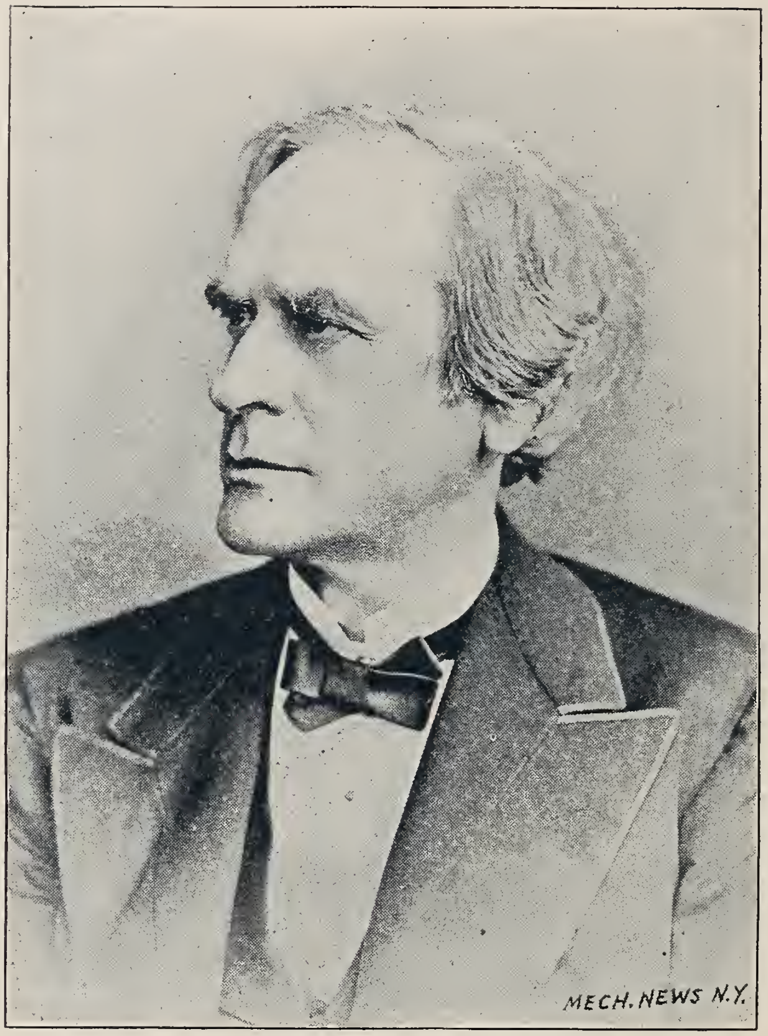
The pipe seen at the right of the machine is part of, or connected to, an injector, which by means of direct steam can be employed to exhaust the air from the water pipes and from the main pumps, to which they are connected, charging the latter with water. The same thing can be accomplished by starting the air pumps to fill the main pumps with water by exhausting the air.

The air pumps are driven by means of the band wheel between them, and the machine being dual in every way, one side can be used independent of the other, as the duty of the main pumps or the amount of steam used may require.

TIN MACHINES.

We have received from Messrs. Merchant & Co., of Philadelphia, a drawing and description of the Buckman Automatic Tinning Machine, by which it is proposed to treat the plates continuously and progressively by machinery. It is perhaps too soon to form a positive opinion respecting the practicability of such a method of treatment, especially in the light of much effort in the same direction that has preceded; but of one thing we may be sure, that when the people of this country take up the machine processes of any art, they are very apt to succeed. In this case the lineal feed of the machine is to be 40 feet per minute, passing successive operations, such as scouring, washing, drying, edging, fluxing, tinning, dusting, shearing and reeling; the whole distance traveled, or the length of the machine being eighty feet.

There does not seem to be any inherent difficulty in such a method of progressive machine treatment, unless it be in the thermal conditions. Mechanically, there will be no impediments that can not be overcome. The feature to be questioned is in so extensive a combination where each part depends on the whole, but this has no doubt been considered and provided for as far as possible.



GEORGE HENRY CORLISS.

We are indebted to the *Mechanical News*, New York, for the above portrait of Geo. H. Corliss, and publish it in a belief that it will be of much interest on this Coast, where Corliss engines are so extensively made and widely known.

Mr. Corliss was a native of New York, being born at Easton, Washington county, in that State, in the year 1817. We had the pleasure of his acquaintance throughout the most active period of his life, and well remember the works of Corliss, Nightingale & Co., at Providence, which were at the time the only establishment of the kind in this country that was from the beginning laid down with a definite plan to include future extensions. Whatever was added was an integral part of a contemplated whole, but whether this was carried out in later years we cannot say.

The portrait of Mr. Corliss is one of his later years, and while it conveys an exact idea of his features, is not as robust as he appeared from 45 to 65 years of age. He was a tall man of commanding appearance and manner, who had confidence in himself, and an administrative ability not often combined with high mechanical skill.

He was one of the few who are endowed by a kind of intuition with the power of discerning mechanical qualities and functions. Beginning as a clerk, then a trader, he drifted into invention, making first a sewing machine for leather; then built a bridge, and afterwards went to Providence, R. I., where he conceived of the Corliss liberating gearing for engine valves, and other characteristics that go to make up the type that bears his name, and the works before named were built to carry out his proposed improvements.

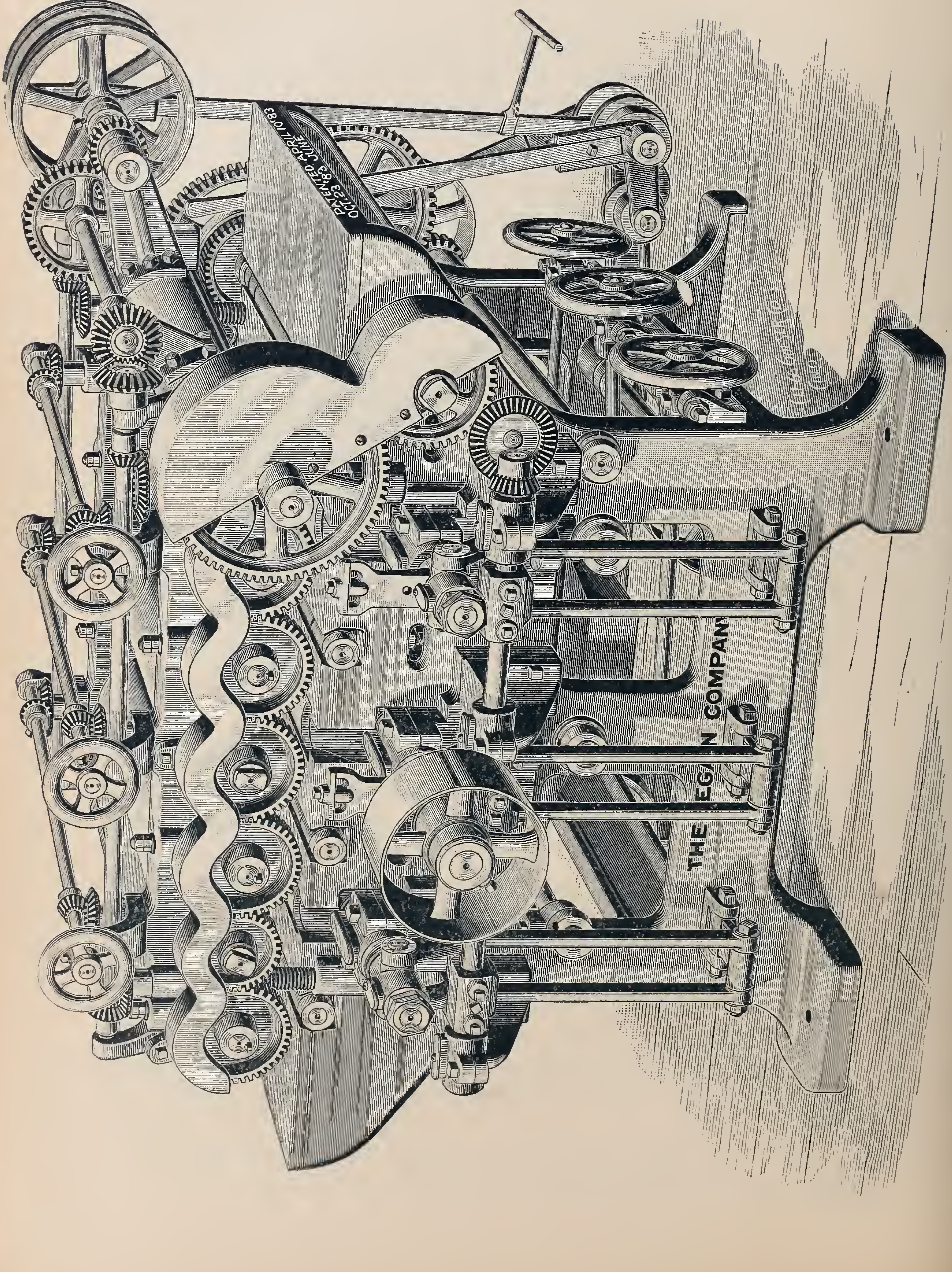
Taking into account the various points of departure from practice as it then existed, his engines embraced more novelty than any one man had ever before ventured upon since the time of James Watt. The four oscillating valves, the wrist plate with its peculiar functions, the let-go gearing of the induction valves for regulating by the point of cut-off, and the general design, were all so novel that people feared for the result and would not buy the engines.

Corliss & Nightingale, to show their confidence in the result, prepared specific contracts wherein they agreed to remove old engines and substitute the new ones for the saving in fuel effected in a certain period of time; also warranting continuous duty and better regulation and service. This was unanswerable, and the Corliss engines began to spread, and continued to do so, until they went all over the world.

The testimonials received by Mr. Corliss for his inventions from various foreign countries bear witness to the value attached to his work. He received the Montyon prize of the Institute of France, the highest honor that can be conferred for mechanical achievements.

It is nearly impossible for anyone at this day to realize the state of the art forty years ago when the Corliss engine was produced, with all of its essential features almost as they now exist. Present practice is not what we must compare with. The "science" of heat engines did not then exist, and there was not then as now, a clear indication of mechanism in the thermal conditions of operating. It is almost miraculous, however, that in 1844 to 1848 there was an engine designed which is made at this day in successful competition with all the other designs that have appeared since that time, in this, and other countries.

Mr. Corliss died in 1888, at 71 years of age, and has left a heritage that may well challenge emulation.


THE EG N COMPANY

WOOD-POLISHING MACHINERY.

THE EGAN COMPANY, CINCINNATI, OHIO.

We were glad to have received the drawing opposite, as it will assist in explaining a machine of high utility, which seems quite unknown among the "mill men" on this Coast, or in this City at least.

We have on former occasions commented on the surprising fact that ceiling and other planed stuff as prepared here for finishing, is a disgrace to the mills, and a source of annoyance and expense to contractors and those who build houses. There is not in this City, so far as we know, a single-drum, sand-papering machine, employed on joiner work, and all surfaces, except doors and sashes, to be finished in any decent manner, either for painting or varnishing, require to be hand planed and sand papered.

Work thus done, and poorly done at that, costs twenty times as much as if performed by a machine such as is shown above, and we doubt if there is another city or place in the world, and certainly none in this country, where so much woodwork is done, that these polishing machines are not in use. These remarks are strong and are in a measure inspired by having just paid out about $50 for hand-planing redwood ceiling, that would have cost at the mill about $3 or less if there had been proper machines there for the purpose.

With this for a preliminary we will say that the machine, shown on the opposite page, called by the makers a "Triple-Drum Sand Papering Machine," seems to be the most perfect one that has appeared. In the Eastern States we would explain its peculiarities and qualities as compared with other and earlier machines of the same class, in other words, would give a technical description of it, but this would be useless here where the inference is that it must be treated as a new discovery. We will therefore say, the machine is for polishing flat surfaces of all kinds by means of drums covered with web sand paper. The material is fed through continuously by strong feeding rollers, the same as in a planing machine. The sand-paper drums are below, and are adjustable separately, so they can operate successively with paper of different grades or numbers, and so that one, two or three drums can be used as occasion may require.

The whole operation is automatic, and as fast as fifty men can do the same work by hand, or try to do it, because hand work is much less perfect, and does not produce a level surface as the machines do. Another point of economy, if any were needed, is that the wear, or the work done by a given amount of paper, is three times as much as in the case of hand use.

These machines are made of various sizes, by the Egan Company; to operate on work 30 to 60 inches wide, and, as before said, to do the work of fifty men, or rather to do work which fifty men cannot do.

It was our privilege many years ago to try some experiments respecting the efficiency of sand-paper used by hand and on a machine. There were no machines like the one in the drawing made at that time, only buffing drums made of wood, covered with some layers of soft cloth, and a canvas cover put on over the top, fastened with nails at the edges.

This canvas cover was spread with stiff glue, and the wheel rolled in a sand trough until the surface was coated like sand-paper. When the wheel became smooth the canvas cover was stripped off, soaked in water until the sand came off, and then nailed on again for a new coat.

The experiment consisted in covering a wheel with sheets of common sand-paper laid on with glue on top of the old coating, and without soaking it off. Everyone predicted that the sand-paper would soon wear out, but, to the astonishment of all, eight sheets mounted in this manner would do more work than fifty would if used by hand.

Web paper soon followed, and was made of a superior quality so its endurance was increased, and it was convenient to apply. Now there are quick means of fastening the sheets without glue, power feeding appliances, and the art is seemingly perfect and well understood all over the country except on this Coast, where we suspect the carpenters are in league with the mill owners to oppose the introduction of such machines. There are in use a few radial disc machines, but these are of little use except on sash or other small framed up work.

THE TECHNICAL SOCIETY.

This Association held their regular meeting on July 1st, Mr. C. E. Grunsky presiding.

The following new members were elected :

For Members :

M. P. Boss, Mechanical Engineer........... San Francisco, Cal.
G. W. Sherwood, Civil Engineer..................Riverside, Cal.

For Associate :

W. R. Phillips, Draftsman.......................Seattle, Wash.

Three new names were proposed for membership, and referred to the Executive Committee.

The President sent in the following communication :

"Mr. Andrew Fraser, a mining and mechanical engineer, of this City, member of our Society, a great, noble-hearted man in the prime of life, a friend of all who knew him, distinguished in his profession and in all connections—was foully murdered, supposedly by a native guide, between Chihuahua and a mining district two hundred miles distant in Sonora, Mexico, while traveling on business for the Risdon Iron Works, of this City, where he had been connected for several years past. He was fifty-four years old. His loss will be mourned by a wide circle of friends, here and elsewhere."

Upon motion the Chair appointed a committee of three, consisting of Messrs. R. S. Moore (chairman), L. C. Russel and E. A. Rix, to draw suitable resolutions of respect in memory of the member whose useful life had been so suddenly brought to an untimely end.

Mr. Hugo P. Frear, chief marine draughtsman of the Union Iron Works, then read a paper entitled "A Problem in Launching," in which he discussed a method employed in completing the necessary arrangements for launching the steamer *Peru*, recently built at the Union Iron Works.

The paper is printed in full in our present issue, and, so far as we know, is an exploration in a new field. The diagrams, as will be seen, are a very extensive and successful example of dealing graphically with varying forces and their relations.

At the next regular meeting on August 5th, Mr. J. B. Pitchford, of San Francisco, member of the Technical Society, will read a paper on "High-speed Corliss Engines," dealing especially with what is known as "Pitchford Corliss Engines."

MECHANICS' INSTITUTE.

The Secretary of the Mechanics' Institute, pursuant to a resolution adopted on the 11th of June last, has sent out to the membership a circular setting forth as below, three plans for extending the facilities and room of the Institute. These plans are suggested by a committee appointed March 1st last, to consider and present a scheme to the Board of Trustees. The following are the methods suggested:

"*Plan One.*—If deemed practicable by competent architects and builders, to remodel the present building on Post street, adding another story and putting in a swift-running elevator and all modern improvements, using the entire building, if necessary, for library and institute purposes. This plan will give us sufficient room until the growth of the City renders it expedient and desirable to build on the Pavilion lot at Larkin and Hayes streets.

Plan Two.—To build on a portion of the Pavilion lot, bounded by Larkin, Hayes, Polk and Grove streets, a large and commodious library building of the most approved construction and arrangement for library and institute purposes, with ample room for all requirements of the Institute.

Plan Three.—To purchase a lot of suitable size in a locality bounded by Powell, Post and Market streets, and erect thereon a library building similar to plan No. 2. In case this plan is adopted, it is probable the Post-street property will have to be sold, as also that on Folsom street."

Members are requested to indicate their preference among three different methods, and will no doubt do so if they can, because it is a matter of much interest, as well as one of great importance to the Association and to the City, but there is the objection that the propositions are too briefly stated, and are incomplete without estimates of expenditure, time of completion and other things.

The Builders Iron Foundry of Providence, R. I., is now finishing and assembling for the United States Government, for coast defense, forty-three twelve-inch, breech-loading rifled mortars, making, with those finished under a previous contract, seventy-three guns of this type from the works of this Company. A part of these will, no doubt, be sent to this Coast, where preparations have been made for mounting them.

Electricity.

PHYSIOLOGICAL EFFECT OF ALTERNATING CURRENTS.

Professor E. J. Houston, in May last, delivered a lecture before the Electrical Section of the Franklin Institute at Philadelphia, in which he offers explanation of the wonderful results produced or discovered by Mr. Tesla, commented upon in our last issue. These results were briefly stated. Alternating currents of high frequency can be passed through the human body without injury. This proposition has called out much comment, and is answered by Professor Houston as far as present light on the subject permits. His lecture is as follows :

"I have concluded to place on record a brief statement of the substance of some remarks made by me at the last meeting of the section, concerning the physiological effects, on the human body, of alternating currents of very high frequencies.

As is well known, the physiological effects of alternating discharges of but moderate frequencies are more severe than are those of steady currents of the same current strength. As, however, the rapidity of alternation increases, the severity of the physiological effects decreases, until at extraordinarily high frequencies, all harmful physiological effects practicaly disappear.

Three varieties of electric discharges or currents are employed in electrotherapy for the treatment of diseased conditions of the body.

(1) The steady, continuous currents produced by voltaic batteries and called, in electrotherapeutics, Galvanic currents.

(2) The alternating currents produced by induction coils and called in electrotherapeutics, Faradic currents.

(3) The electrostaic discharges obtained from frictional or influence machines and called in electrotherapeutics, Franclinic currents.

As is well known, the physiological effects produced by Galvanic currents differ markedly from those produced by Faradic currents. The former, unless very powerful, produce on the opening or closing of the circuit, a contraction that is of very short duration — in fact almost but momentary ; the latter produce a contraction that continues as long as the current is passing. This is generally believed to be due to the fact, that the contractions attending the opening and closing of the circuit, follow one another so rapidly that the muscles fail to assume the condition of rest and so present the appearance of continuous contraction. Franclinic currents, produce in general, effects somewhat similar to those of Faradic currents.

When alternating currents are sent through the human body the physiological effects increase in severity with an increase in the current strength. With current strengths greatly in excess of those employed in electrotherapy additional effects are produced, and a tonic contraction of the muscles follow. Moreover, in such cases the severity of the physiological effects is increased by the high potential of the break-induced discharge.

As, however, the rapidity of alternation increases, the severity of the physiological effects decreases until when enormously high frequencies are reached, the discharges become harmless. These facts have been demonstrated by Dr. Tatum for comparatively high frequencies and by Nikola Tesla, for enormously high frequencies.

In a lecture delivered before the American Institute of Electrical Engineers, at Columbia College, New York, on May 20, 1891, Tesla speaking of these effects, says:

'I have found that by using the ordinary low frequencies, the physiological effects of the current required to maintain, at a certain degree of brightness, a tube four feet long, provided at the ends with outside and inside condenser coatings, is so powerful that I think it might produce serious injury to those not accustomed to such shocks; whereas, with 20,000 alternations per second, the tube may be maintained at the same degree of brightness without any effect being felt.

This is due principally to the fact that a much smaller potential is required to produce the same light effect and also to the higher efficiency in the light production. It is evident that the efficiency in such cases is the greater the higher the frequency, for the quicker the process of charging and discharging the molecules, the less energy will be lost in the form of dark radiation.'

The severity of the physiological effects attending any electrical discharge through the body must necessarily depend to a considerable extent not only on the quantity of energy present in the discharge, but also on the time in which it is acting.

It has occurred to me that in another circumstance is to be found perhaps, the principal cause why discharges of enormously high frequency of alternation should be so comparatively harmless. This fact, I think, is to be found in the manner in which, according to our modern ideas, an electric discharge is believed to pass through a conducting path or circuit, viz: that the electric energy is not propagated through the mass of the conductor itself, but rather through the dielectric or other medium lying outside the conductor. That the electric energy is rained down on the surface of the conductor from the space outside it, and sinks down into the mass of the conductor, the conductor forming a sink or place where the energy can be dissipated.

In the case of a steady, continuous current, the energy sinks or soaks rapidly through the mass of the conductor, so that the electric current, in the language of the old ideas passes through all portions of the mass of the conductor.

In the case of alternating currents, however, the energy received from a single impulse or electrical movement, by sinking or soaking moves (say) from the surface of the conductor towards the center, only while such impulse continues; and when the direction of the impulse changes, moves in the opposite direction, or towards the surface. In conductors through which alternating currents are passing, the current density is therefore greatest near the surface portions, and in the case of alternations of very high frequency, the central portions of the conductor are entirely free from electric currents, the current being limited to portions near the surface.

In the case of the enormously high frequencies employed by Tesla, this action was so pronounced that conductors failed completely to conduct.

When therefore, the human body is subject to the effects of discharges of alternating currents of enormously high frequencies, the superficial portions only are traversed by the discharges. The more deeply seated, vital organs, being thus free from current, such discharges are necessarily harmless.

As the frequency of alternation increases, the body becomes more and more protected, until when the frequency becomes as great as that of the ether waves, which cause sunlight, they would probably produce on the surface of the body, the same genial effects as are produced by the light and heat of the sun, with which they are probably identical.

If these views are correct, it would appear that when the human body is exposed to rapidly-alternating discharges, it is subjected at one moment to a discharge that might produce instant death, were it not for the fact that the bolt is practically no sooner hurled at the body than it is hurled away from it."

The tenders for supplying electric lights at the Chicago Exhibition are bewildering. An arc lamp, or an incandescent one, of defined candle power, to be maintained with a sufficient current is as near a standard and uniform product as anything that can be referred to, but the bids at Chicago varied from $399,000 to $1,713,567, or as 4.3 to 1. What this means has not been explained. The Westinghouse Company secured the contract, and were asked to file a bond of $1,000,000 for their performance of the stipulations requiring 92,622 lamps. This was another mystery in the case, considering that the Company is quite able to furnish the lamps and all the rest. The bond was afterwards reduced to $500,000. As the electric plant will answer in a very effective way as an exhibit, it was natural to expect a low tender for the service.

Mining Notes.

There are, just now, at Creede, in Colorado; at White Hills, in Arizona; and in Northern California; camps being opened up that have more promise than any that have been discovered for some years past, and it should do something toward relieving the congestion of trade in this City. It is reported that the principal mines at White Hills have been bought by investors in this City.

The Granite Mountain Mine, in Montana, with ten millions of stock, is producing 500,000 ounces of silver a month, which exceeds the output of any other mine in the world. There are no signs of exhaustion of the ore, and fifty years of reduction will not consume what is known to exist, unless all rules and conjectures fail. Last year $360,000 was paid in dividends to the shareholders, and in all nearly twelve millions have been paid out of the earnings. If discoveries of the kind go on, and there is no reason to doubt it, silver will become more extensively used in the arts, and will fall in price, especially if the cost of mining and extraction are continually cheapened by new inventions.

It would be interesting to know in what measure the decline of the Comstock mines is due to stealing. Mr. Tingman, president of the Mining Stock Association in this City, stated in a lately published letter, that Senator Sharon's estate was derived from proceeds stolen by the Union Mill and Mining Company; also the fortune of D. O. Mills and others. The whole amount thus taken, he reckons at $60,000,000, which alone would be a great draught on the Comstock mines, if extracted from profits, or what produced profits. The Comstock Milling Company followed, and thirdly, the Nevada Mill and Mining Co., all of them conducted, as is claimed, on the same plan as the first one. The chances are, that the Comstock mines would now be profitable property if not "looted" by these unscrupulous methods. A great share of the money stolen in these milling schemes has been drawn out of California in "assessments," principally from those who owned small amounts of stock.

We have made it a point, for two years past whenever opportunity offered, to ascertain the opinion of mining engineers respecting the Temescal tin mines in San Bernardino County, and have always met with the same views, which are in substance that no tin existed there in paying quantities. If there had been ore rich enough to pay for extraction there would have been no need of an expedition to England to sell the mines. Present circumstances indicate that $2,000,000 have been wasted there, and the effect of this circumstance, to say nothing of its moral aspect in the past, must act disastrously on mining interests on this Coast for a long time in the future. Two years ago we pointed out how this ore was near tide water, and that those in England or Wales who wanted to invest in the mines should, for a time, take the ore out to the smelters in Swansea, and reduce it there until the percentage of tin was definitely known. Even this could not guard against a lack of ore in the mines, respecting which no skilled opinion has, so far as we know, ever been published in this country.

The following extract is taken from a recent paper read before the Institution of Mining Engineers, in England, relating to mining in New Zealand :

"In the older gravels filling the deep watercourses, where no outfall can be got for sluices, the auriferous dirt is disintegrated by a water jet, and lifted by the same agency to a sufficient height for the subsequent washing process. Much interesting information as to the working of this process was given by Mr. C. E. Rawlins, a member who had lately arrived from New Zealand, from which it appeared that auriferous gravel could be raised from 80 feet to 90 feet by water at 800 pound pressure, at a cost of about 1¼ pence per ton for labor; the elevator being a steel pipe into which the gravel is carried by a jet of water and delivered against a baffle-plate at the top, where any hard lumps are effectually pulverized by the collision. This plate, and the portion of the pipe immediately adjacent to the nose of the water jet, are the only parts that are much affected by the scour; the rising pipes, which are of solid drawn steel, No. 12, B. W. G., and 15 inch inside diameter, showing but little wear. The admission passage is protected by a hard metal lining, white cast iron having been found to stand best, but it requires frequent renewal, and it is intended to try the strongest variety of Hadfield's manganese steel, which should be well suited for the purpose."

Local Notes.

Mr. E. H. Booth, of the Thomson-Houston Company, writes to point out an error in printing his article on "Electricity, as applied to Mining Operations," in our June issue, by which the writer's meaning is reversed. In line 27, on page 463, the phrase, "and is met with to an equal extent," should read, "and is not met with to an equal extent." It was a blunder in printing we much regret, and due to the impossibility of reaching Mr. Booth with proofs, he being at the time in Montana.

The letter of Mr. Samuel S. Webber, relating to the speed of Corliss engines, published in the present number, will cause some astonishment here, where there has been a pretty constant effort to increase the speed of Corliss engines, or their valve gearing, which has been a limit of speed. Mr. Webber is a well known engineer, and will no doubt, supplement what is given in his letter by other particulars if requested to do so. The number of revolutions given is at least twice what is commonly considered a limit for engines of the size and kind named.

The executive committee that managed the reception and entertainment of the American Society of Mechanical Engineers, during their convention here, in last May, met on the 9th ultimo, and after auditing all accounts for expenses incurred, found they had a balance in their hands equal to 40 per cent. of the subscribed amount, which they arranged to return *pro rata* to those who contributed to the fund. The entertainments by Mr. Charles Webb Howard, Adolph Sutro, and in other cases, were a personal matter, and tendered free of expense to the committee, thus much reducing the amount that would otherwise have been expended. Letters received from the officers of the Society since its return to New York indicate that their reception here was a surprise, and their entertainment far beyond anything expected or imagined, and that the occasion will long be remembered as a particularly happy portion of the Society's history. The whole was well managed, and our City has gained thereby an important quantity of good will.

The consolidation of the Pacific and Regan Gas Engine Companies in this City is likely to enable a more systematic and profitable manufacture of the engines and save a great deal in the expense account. Segregation is almost a necessary feature in the development of manufactures. A large business is too unwieldy for experiments, and there is no means or incentive for personal effort, such as is demanded in "working out" new things, hence the business of the Gas Engine Company has only followed a normal course up to that point where stock engines can be accumulated and orders filled promptly. The Company have recently furnished to a local firm here an engine of sixty horse power, having four cylinders of ten inches bore. The design is good, plain, substantial, following the latest and best practice in steam engines. The engine is "auto-starting," if that term will do. One cylinder is charged, and a single impulse moves the engine through one cycle, or far enough to meet the automatic action of the other cylinders.

The removal of the silk factory of Messrs. Carlson & Currier to Petaluma is fortunate for that city and a proportionate loss to San Francisco. It was an industry the importance of which cannot be measured by the investment, or any of the ordinary rules, because the work performed was in a sense skilled, well paid for, and mainly performed by women who were far above the common factory class. There are very few clean and fitting pursuits open to women that will maintain their social standing, manners, and support them in a comfortable way. Messrs. Carlson & Currier employ about 200 people in an industry which did not compete with others here, and was a distinct addition to our industrial interests. The silk spun is brought here from China and Japan, and was spun into sewing silk of all grades, colors, and quality. Petaluma secured the erection of the works there by liberal concessions that will, no doubt, be amply returned. The main building is of brick, 160 × 45 feet, and requires an engine of 100 horse power. The product is to be 75,000 dozen spools of silk per month.

What has become of the much talked of Eames Steel Works, at San Diego? This Journal was criticised for showing how the Eames or any other special process of steel manufacture was an absurdity, and also that in the other case San Diego was not the place to found such a manufacture. We refer our readers to the result, which now seems to be that a mythical English company is to supplant Dr. Eames and build the steel works, An impression to be gathered from reports of a year ago was that the output of steel was nearly ready, the vast works nearly complete, and so on, but like the great tower at Chicago, the works did not "materialize." The effect of these things on our industrial interests on this Coast is disastrous. It prevents legitimate investments, destroys confidence, and earns for us an unenviable reputation. Every year sees three to a dozen of these "great schemes," consisting of mere "conceptions" or fancies, born among those who know nothing of the economic and commercial conditions that must exist for the successful founding of manufactures.

At a meeting of the members of the Mechanics' Institute of this City, on the 12th of June last, some schemes were reported by a special committee respecting an extension of the library facilities and room. A proposed director, or trustee, nominated by the board itself, to fill a vacancy, was rejected by a vote of the members, and in this act is seen a circumstance almost without parallel. The members of a corporate body contending with elected trustees. The matter is not one for comment here. It was decided to hold an exhibition in January and February of 1893, instead of in the Autumn of this year, as would have been in regular recurrence. We think 1894 would have been better. These exhibitions, in so far as promoting industry, are far too frequent. The changes and additions of a year do not form enough subject matter. There is no novelty to speak of, consequently not much interest. A committee to revise the constitution and by-laws of the Society was ordered.

COMMENTS.

The meeting of the Amalgamated Association of iron and steel workers that held their convention at Pittsburgh last month, and the proceedings there indicate that whether employers understand or not the principle of setting off labor as an element of production, the workmen have, and are, moving in that direction. In several articles on "profit sharing," and as a corollary of that proposition we have endeavored to show how this independent treatment of skilled labor is practicable and practiced, and that profit sharing held out no solution of the labor problem. We have no hope of seeing, within a decade, any popular understanding of the subject, but the logic of events point that way all the time, and the whole will be understood in the end. As soon as the employers and unions discover that the amount of wages is the thing to be considered instead of a rate paid for a man's time they will be at the beginning of the end, and perhaps the machinery of the labor bureaus will be turned to an investigation of that fact, the central one of all, and in that case strikes will become less frequent.

Mr. C. E. Grunsky's communication to the Technical Society of the Pacific Coast, reprinted in our last issue, raises the inquiry of what has become of the American Society of Irrigation Engineers, founded during the Congress held in Salt Lake in 1891. A special meeting was held at the rooms of the Polytechnic Society in Salt Lake, an organization was made and officers appointed. If any of our readers have any knowledge as to progress made since then, it will be a favor if such information is sent for publication. It is evident that the treatment of the soil as now understood and taught in our agricultural schools and colleges, falls far short of what is required to be known in respect to irrigated lands and the peculiar conditions and nature of soils met with on this Coast, especially. The amount of mineral salts of one kind or another with which the earth is impregnated, and the treatment required to counteract these salts is a feature which we imagine is little understood in districts where the land is washed by a regular annual rainfall covering all seasons. The conservation and distribution of water is alone an extensive branch of engineering, and there is certainly call for such means as will concentrate study upon irrigation engineering.

The political platforms or manifestoes issued this year by both of the principal parties contain clauses relating to the danger of railway appliances, especially couplings, and the fact has significance in so far as showing that the enormous number of accidents is engaging public attention ; but in so far as a remedy by laws, that need not be looked for in any direct form, or in any form perhaps. The "political" idea is not, we fear, of the humanitarian kind, but to catch votes. If this killing, maiming and destroying was done by "water lines" there would soon be laws and regulations, and inspection, but with railways it is different. The only remedy possible is to enforce the liability of the companies under laws that now exist, or some new act of general application. A man who engages to work on a railway, and to couple cars, assumes a risk equal to one in ten of being killed the first year, and this will, no doubt, continue, until the companies are compelled to insure his life. It is only their reasonable duty to do so, and when such a regulation is imperative there will soon follow such safeguards as human skill can devise.

The deplorable riot, at the Carnegie works, Homestead, Pa., that occupied the attention of the country during the first of last month, has not offered any new light on the various disputed points at issue, or disclosed any new truth ; in fact truth does not seem to be the element sought after. A Congressional Committee was sent to Pittsburg, and, among other things, tried to ascertain the amount of wages paid per ton in steel manufacture. This is rather an important matter in the problem, inasmuch as a number of the newspapers claim that Mr. Carnegie's money and business are creations of the laws protecting or promoting his manufactures. If that be true there is certainly some public claim upon both, and that, no doubt, is the view taken by a good many of those concerned. The employment of armed men to operate against the strikers, and transporting these men on a navigable river, terminated as must have been foreseen, and to the disgrace of the authorities provided to maintain order in such cases. The history of labor disturbance in Pennsylvania is an ignoble one. The report of the Senate Committee on labor troubles in the coal regions, in 1886, should have been issued to the country as was intended, and might have been the cause of some much needed reform in the coal and iron industries.

There was a great flurry in England and some other European countries last month, over a circular issued to the American Consuls in March last, declaring that exhibitors at the Chicago Exposition would not be permitted to affix prices on their goods exhibited there, unless the American duty was added to such prices. As the Exposition is a bonded warehouse in effect, and as European exhibitors have in view the display of their wares to other countries, as well as this one, the absurdity of such a regulation is apparent. After a good deal of telegraphing and corresponding, the matter was set right, but came very near "upsetting" the whole affair in so far as exhibits from England, France and Germany. We have well escaped a charge of bad faith in the matter. At the Centennial Exhibition of 1876 this same thing was done. There was no previous regulation, and exhibitors were no little astonished when their goods were in place, to be informed that the prices could not be marked on them unless the duty in this country was added thereto.

The Maxim flying experiments in England are at an end, and we can be credited with one more prophecy fulfilled. It is reasonably certain that no reasonable person will ever again attempt to sustain weights in the air by means of mechanical agents impelled by steam power, or any other power at present known. This is presumable on the grounds of impracticability, and also for the want of an object in sustaining and conveying weights in the air. No one wants to go that way, which from inherent causes can never be as safe, or even as fast, as conveyance on the ground or on the water. The late paper of Mr. Marsden Manson on the "Circulation of the Atmosphere of Planets," and the facts therein set forth, shows that in the attenuated outer strata of air, it would not require but a day or less to pass around the earth, but this is under circumstances where animal life is not possible, and the lower strata next the earth and travelling with it, is in every way inferior to the present methods of transporting either passengers or goods.

Industrial Notes.

The valve motions, or the valve functions, they may be called, of the Dow steam pumps, made in this City, affords an example of what may be called "generalization" in construction. They have a main valve moved by steam pistons, and a second or auxiliary valve to distribute steam to the pistons that move the main valve. This far there is no difference from other pumps of the kind, but to move these two valves the same mechanism is employed up to the closing point of the main valve; then the auxiliary one, being a little in advance, opens its induction part first, setting the steam piston of the main valve in motion and completing its stroke. We have here then the main valve moved by direct connection to the piston as far as possible, and the stroke then "completed" by an auxiliary agency, the whole accomplished by the same valve rod and gearing.

Mr. W. A. Doble, of the Abner Doble Co., in this City, recently conducted some experiments to determine the proper temper or hardness of steel exposed to blows, as on the ends of driving tools, such as drills, chisels, wedges, and at the same time of hammer faces exposed to similar action. The steel used was Firth & Sons' tool cast steel, and its endurance was far surpassing any estimate that would be formed by inference. A piece of steel about 8 inches long and 1¾ inches square was shaped like the driving end of a wedge, and hardened to a particular temper, known by experience to be correct. The other end of the piece was slightly tapered, and set solidly into a block of iron weighing 1,100 pounds. Two relays, of three men each, were set at work with sledges of 10 to 13 pounds, striking "in time," with full force on the head of this steel piece to see how long it would last until it would "fly" or "broom." As soon as one set of men were tired the others took their places, delivering from 90 to 100 blows a minute. This continued for eight hour's time, and the piece, when we examined it, was in good condition, not an ounce spalled off, and no cracks of more than .5 inches in length or depth. Assuming that the blows were 90 to a minute, or 5,400 an hour, the aggregate would be 43,200 blows from sledges swung through a circle of 6 to 7 feet. Mr. Doble assumes, and no doubt with full truth, that at certain temper or hardness, a particular mean between the friable and malleable conditions of steel, it takes on an elastic condition, and is capable of endurance that enables a long life to driven tools, and, as at first remarked, far surpasses what is commonly supposed to be a limit. The place of cast steel in the useful arts is not likely to be displaced. There is nothing like it, or scarcely to be compared in the way of endurance under blows.

The Lodge & Davis Machine Tool Company, of Cincinnati, Ohio, have brought out a new radial drilling machine that is the best designed implement of the kind we can refer to. The proportions throughout seem carefully worked out, and the design, except some brackets of cylindrical section to support out-board bearings, is symmetrical and pleasing. One chief feature, neglected in nearly all machines of the kind, is the reducing or back gearing being placed on the main spindle instead of some driving shaft, that permits the spindle to make a quarter revolution or so, by torsional springing of the parts. A heavy sole-plate and box-table combined, with racks for drills, a tapping motion and all required adjustments, are well combined and arranged.

LITERATURE.

Bulletin No. 42 of the United States National Museum.

This issue of 256 pages is devoted to mineralogy and mining, with a large number of fine plates. It is a work of value to mining men and metallurgists, and contains a great mass of information which is in some cases lacking in accuracy. For instance, on page 28, a description of the Ontario Mill is set down as one of 80 stamps, while Professor Stetefeldt, of this city, who designed the works, informs us that there are but 40 stamps. He says the screens given as 30 mesh should be 26 mesh, and that his furnace there is six feet square at the base instead of eight feet as given, and is fed at two sides instead of one side; also, that the yield instead of being 100 ounces per ton, as reported, is only 35 to 50 ounces per ton of ore. Statistics of the kind are difficult to collect, and when collected are soon succeeded by new quantities and circumstances. On the whole, however, the book is one of value, and many men will do well to procure copies.

Consular Reports.

No. 139—April, 1892.

The present report of 220 pages is in some respects a peculiar one, being confined to two subjects, namely: "Local Transportation" and "Underground Conduits for Electrical Wires."

The inquiry sent out from the State Department, respecting local transportation called for explanations of methods, how owned, rates of fare, rate of taxes on service, and if the investments were profitable.

The section for underground conduits was defined, "Underground Conduits for Telephone, Telegraph, Electric Light, and Electric Power Wires."

In respect to the first section, relating to what is called "Local Transportation," meaning thereby urban transportation or traffic, it contains a large amount of information which does not admit of useful comment, and we fear not of much practical value in this country, except in suggestions respecting legislation to govern such lines.

Wherever the matter is mentioned, the street lines in all countries are forbidden to cram the carriages, and passengers are not permitted to enter after the seats are filled. This is an uniform evil of our system. The seats provided are not enough, and the discomfort of people crowding into the cars and standing is an outrage. The common reply to remonstrance is it cannot be avoided, but here is testimony from all parts of the world that it "is avoided," and no such system is permitted elsewhere.

Looking over all, one is led to think American cities are better provided in respect to public conveyances, except as to crowding, and scarcely provided at all with facilities for personal or private conveyance.

The section on underground conduits is one of much interest, but being a technical subject, could not be dealt wlth by consular officers farther than to give some facts and statistics, which, from all the European cities reported, indicate that overhead wires are not tolerated in the denser parts of any of them.

There is little doubt as to the practicability of underground conduction. It is only a matter of investment and methods, and it would seem that this problem is swallowed up in the more difficult one of supplying moving motors for traction from underground wires, that is if the latter is at all practicable, the other is out of the problem and a simple matter.

The diversity of methods is bewildering, and is such that comment is useless. Nothing but time can prove the advantages of one or the other.

The Engineering Magazine, July, 1892.

In this number Mr. George E. Curtis, "Meteorologist to the Government Rain-Making Expedition," details the circumstances of the ridiculous expedition to Southern Texas. The record is not worth remembering, and the report is nearly a year too old. Its significance will be seen in the last paragraph, as follows:

"This aftermath of the rain-making experiments, although unforeseen, serves as an excellent warning. For the honor and good name of the Government, and of science, it would be well if we had seen the last appropriation to produce rain by bombarding the heavens, and the last expedition which should mislead the people by sending out premature and sensational reports."

We notice that a dispatch sent to Chicago reads "The Hon. B. Farwell, Chicago. Preliminary.—Fired some explosives yesterday afternoon; raining hard today."

If we remember correctly, this Mr. Farwell is the member of Congress who secured an appropriation to build some kind of a novel war vessel evolved from his inward consciousness, and is no doubt a representative of the genus "crank," which is naturally represented among the members of a popularly elected legislative body. We once claimed that the object of the whole rain-making scheme was a raid on the treasury by people owning patents on rain processes, and Mr. Curtis could no doubt have said so, if official courtesy had permitted.

Mr. Louis Heilprins' article on "Rapid Transit in New York City," is an attempted generalization of the matter, and will give some idea of the problem which the Rapid Transit Commission has before them. We think, however, that Mr. Heilprin overestimates the difficulties to be overcome in New York, even if it had two millions of people to deal with. The city is long and narrow, giving short lines of exit and long lines of border. There is water transit in nearly all directions, reaching habitable areas in 10 to 40 minutes. The future will no doubt see a larger increase of this radial transit by water than of the "up-town" travel, which now seems to engross all the attention of those considering the subject.

Report of the Division of Forestry.

DEPT. OF AGRICULTURE.

The Chief of Forestry, B. E. Fernow, submits a concise and well-written report for 1891, conspicuous for the information given respecting the varieties of "pitch pine," found mainly in the gulf region. The distribution of varieties is shown by three fine colored maps shaded to indicate grades of quantity per acre.

In 1891, the exports of wood and wood products was $44,811,000, and imports, $21,772,000, or about one half, which is surprising. The information contained in the report, most of it, appeals only to those who deal with forest interests, and consequently has not enough interest in a popular way for a more extended notice here.

Trade Publications.

Messrs. W. T. Garratt & Co., of this City, have issued a new edition of their catalogue relating to pumping and other hydraulic machinery made by that company.

The catalogue, which contains more than 100 pages, is well printed on fine paper, and contains a vast amount of information of use to those who purchase and use this class of machinery, or the various supplies connected with it. It is not necessary, however, to enumerate the contents of the catalogue. The firm and its manufactures are too well known on this Coast to require that, but in the matter of pumps it may be said that the variety and adaptation to special, as well as general uses, is a surprise. The Hall-duplex and the Hooker direct-acting steam pumps, occupy a large space. The special triple pumps and the centrifugal types, have also independent sections, with all kinds of tabular matter that relates to their weights, cost and uses. We do not know on what conditions the catalogue is sent out, and can only recommend our readers to apply for it.

CATALOGUE OF THE E. W. BLISS CO., BROOKLYN, NEW YORK.

The phenomenal development of this vast business during fifteen years past, must to some extent, or even a great extent, be accounted for in the fact that the firm has not only led in the manufacture, stamping, drawing and other plate machinery implements in this country, but in the world. Orders have been executed for nearly all countries, and every month sees new designs for standard or special machines for punching, shearing, dropping, drawing, spinning, and all the cold processes of sheet metal manufacture.

The present catalogue of nearly 400 pages, octavo size, well bound in boards; is convenient, complete, and a book of useful reference in any establishment where sheet metal processes are carried on. As in the case of the previous catalogue mentioned' we do not know the circumstances under which it is published and sent out, but it is an excellent thing to "apply for."

THE JEFFREY MANUFACTURING COMPANY, COLUMBUS, OHIO.

We have received from this company a recently prepared circular containing a wonderful number of engravings representing the various conveying appliances made by that company, also engravings and descriptions of their underground machinery for coal cutting and conveying, The development of that branch of manufacture called "conveying machinery," and its evolution into a class, within a few years past, is characteristic of the pace at which skilled industry is moving in these times. It seems a dream, and consumes one's energies to "keep up," even if that means no more than to understand the nomenclature of trade. The Jeffrey Company are among the oldest in this conveying business.

The Iron Founder.

SIMPSON BOLLAND.

This is an attempt, among some others that have preceded, to write a book of use to moulders, and being the last, is also the best. It contains explanation and description of nearly every process or method known in foundry practice, and has more than 300 explanatory drawings and diagrams, prepared originally for the work. The book is written by a practical moulder, and if not would have been of no use, because the art is not one amenable to calculation, theory, or even set rules. Like other trades that have to be empirically learned, or mainly so, it requires all that can be added by suggestions and advice such as is here given.

Although the title is confined to founding, or moulding in iron and other metals, the book is of almost equal value to pattern makers; in fact the two trades are in practice so nearly connected that a good moulder must understand pattern making, and a pattern maker must understand moulding; hence the dual value of Mr. Bolland's book.

In the chapter on pattern making, or as we should say, the chapter on how to avoid pattern making, there are some useful hints on "strickling," of which not one half as much is known as ought to be, even here in California, where "short roads" to castings are more studied and are more extensively applied, than anywhere else in this country, We saw some years ago a volute centrifugal pump casing cast in Philadelphia by means of skeleton and "strickled," that was a very perfect piece of work. The 42-inch pumps in use at the Mare Island dry dock were moulded in that way.

The work contains 382 pages, and is not "padded;" on the contrary, is as compendious as possible, and is nearly devoid of "machine slang," also technical names that are confusing, and is on the whole, valuable and commendable in every way.

The book is published by Messrs. John Wylie & Sons, New York, and sold here by Messrs. Osborn & Alexander. Price $2.50.

The Californian, July, 1892.

In this issue the descriptive matter is profusely illustrated, well selected and well written, but the most vigorous and striking contribution is the second article of Mr. C. T. Hopkins on the "Education of Politicians."

The subject is one presenting all kinds of objective points, and does not need argument so much as portrayal in such form as to be understood and appreciated. The facts are well known. No one needs to be informed that the political procedure of our day is all that it ought not to be, and growing worse.

Mr. Hopkins quotes in italics the following from an article by President Eliot, of Harvard University, published in the *Forum* for October, 1891:

"Before municipal government can be set right in the United States, municipal service must be made a life career for intelligent and self-respecting young Americans; that is, it must be attractive to well-trained young men who enter it—as they enter any other profession or business, meaning to stay in it, learn it thoroughly, and win advancement in it by fidelity and ability."

He then sums up the impediments to securing trained talent for public service in the following terms:

"1st. The absence of any class properly educated in statecraft from which proper candidates can be selected, and of any institutions for supplying such education.

2d. The absence of such public opinion as at all recognizes the necessity for any special education in candidates for elective office.

3d. The universal dominance of a class of active and unscrupulous politicians whose idea of office is private gain, not public service, and whose principal test of fitness is corrupt subservience to the nominating power. These have no use for educated candidates, whom they love as the rats love the ferret.

4th. Universal suffrage implies the right to hold office (as if it were a property or a power) as the correlative of the mere voting power, and therefore ignorance and incompetence have the right of representation, in proportion to numbers, equally with knowledge and talent. Therefore the more ignorant voters, when in the majority, would deem themselves disfranchised if not permitted to choose their representatives from their own body.

5th. The entire absence of educational qualifications for legislative office in every constitution.

6th. The uncertainty of the election of educated candidates.

7th. The further uncertainty of their re-election, especially under constitutional provisions confining representation to residents in the district, thereby disqualifying non-resident candidates, though in every respect better men.

8th. Extreme partisanship, which everywhere seeks the election of party leaders regardless of their education, knowledge or character."

The most remarkable of all, however, is the author's views respecting the law as a school for politicians. It is common opinion in this country, and one continually acted upon, that lawyers almost alone are qualified for legislative service. Our Congress is mainly composed of lawyers, and to a much greater extent so composed than the legislatures of other countries. On this head Mr. Hopkins says:

"The profession of the law is popularly supposed to be the true education for public life; but Herbert Spencer, in his essay on Political Education, says: 'A familiarity with law is no more a preparation for rational legislation than would be a familiarity with all the nostrums men have ever used as a preparation for the rational practice of medicine.' The political lawyer is a natural partisan. He knows how to work only as an attorney for one of two sides in a controversy. His knowledge of the laws that *have been* made has often no bearing upon laws that *should be* made except to prevent them, owing to his professional adherence to precedent. Nor does the knowledge only of law presuppose familiarity with any other study in our curriculum for an education in statecraft. Nay, further, is the profession that lives by constant contact with fraud and crime thereby rendered pre-eminently honest? Is the practice of taking fees for services in court suggestive of refusing fees for services in the legislature? Have political lawyers no pecuniary interests in statute making, independent of the profits of bribery? Can no relation be traced between the continually controlling presence of lawyers in the legislatures and the thousand needless complexities, costs, delays, appeals and technicalities in probate, insolvency, street assessment and criminal proceedings, all making work and fees for the bar at the expense of a permanent divorce between law and justice? Is it not singular that, under a government so carefully dividing its powers, that the law-making department is left utterly powerless in execution and administration, all three of those powers should be everywhere blindly conferred upon the lawyers? For as legislators they make the laws (often in their own interest), as judges they administer them, and as attorneys they execute them. In protection of the rights of the public ought not lawyers to be *ex-officio dis*qualified to be legislators? What right have they to have any share whatever in framing the laws, out of whose execution they make their living?"

The author concludes that the only hope of checking corruption and reforming the civil service in this country, is to elevate politics into a "learned profession," and as this is the only remedy we remember to have seen suggested, it should on that ground alone receive earnest attention.

The excellent article on Phœnix, Arizona, will be a surprise to a good many even here, where we should know a good deal of that city. The most important fact to be drawn from the description is what it discloses of the agricultural environment there.

Phœnix is thus situated. A fertile valley traversed by an irrigating canal has lent a feeling of permanence and built up good buildings, water works, schools and the rest, including an intelligent and "fixed" population. The mines of the Comstock Lode could not build a true city at Virginia. Mines, commerce, even climate cannot build a city — a permanent one, that demands tilled lands as a base.

The Mount Wilson Railway from Pasadena to the top of the Sierra Madre range is the subject of an article by Mr. Olaf Ellison, open to the objection of being premature and with an advertising flavor. We confess to a strong prejudice against all descriptive writings upon projected or incomplete works.

Except a superbly illustrated article on the ruins of Pompeii, the remainder of the present number is devoted to California, and will have a strong local interest, as well as being useful to those who are to visit this peculiar and beautiful country, or have done so in the past.

"INDUSTRY."

JOHN RICHARDS, Editor.

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Local Notes.

Whatever schemes may lie beneath the Nicaragua Canal enterprise, and its immediate promotors in Congress, no one will question the good faith of Captain Merry, after reading his compendious but complete representation of the subject, published in the present issue. Captain Merry, as past president of the Board of Trade here, and chairman of the Nicaragua Committee of that body, also official representative of the Company in this City, is not likely to forget the interests of his fellow citizens, or to promote willingly any enterprise that will not prove advantageous, now and ultimately. We commend a careful perusal of his essay.

In no branch of industrial engineering work has more progress been made in ten years past, than in elevators for buildings. Horizontal transit reached an earlier solution, and its influence and economic effect in cities is well known. No less marked are the results of "vertical traveling." It has changed rents, the value of ground, and produced results that are marvelous if we consider them. The writer of this, was, an hour before, shot up 60 feet at a rate of 10 feet a second, in the new Pacific Mutual Insurance Company's building, in this City. The control over the movement of the cage is marvelous and perfect. The machinery is on the "hydro-steam" system, constructed by the Cahill & Hall Company, of San Francisco, and is the subject of an essay printed elsewhere in this number.

There is being made in Kern County, Cal., a reservoir, partly natural and partly artificial, that covers an area of 25,000 acres. It is to be filled from the Kern River, and is claimed to be the largest reservoir in the country, which it will certainly be, in area, if we exclude dams in rivers, which in some cases will back over a larger surface. The Kern County works will cost $360,000, which is a reasonable investment if it include the canals of catchment, which lead some distance from the Kern River. The water is to be used for irrigating, and if the mean depth of the reservoir is ten feet, there should be a supply for 250,000 acres.

Mr. Geo. M. Dodge, C. E., of San Rafael, Marin County, in this State, has been laying pipe to conduct the sewage of that town out to deep water. The pipe is 8,000 feet long, with a slope of 3 feet, laid on a uniform grade and nearly straight. He has arranged to indicate the friction head at the intake end, also to record volume. The case is one wherein the ordinary rules respecting the flow in pipes can be determined in a very complete manner. It is not often that an opportunity of the kind occurs, and Mr. Dodge, it is hoped, will tabulate his observations and give them out in a public way before long. A paper before the Technical Society would be a good way to put the data permanently on record.

On the 15th. of last month, there was killed at the Clayburgh building in this city, by an accidental fall, a man who, quite unknown to fame, can nevertheless claim a remembrance far above what fame commonly means — Peter M. Cornell, a millwright and mechanic, who for more than forty years had spent his energies in doing intricate and dangerous work. His honesty, industry, and energy were proverbial, and when one thinks what a monument his life's work would be, if assembled in one place, it will be hard to deny a tribute such as is accorded to trifles in comparison. This man's life represents the work of forty men for one year, or in all 12,000 days work. It would almost build the Palace Hotel, and easily build any other great building of the kind. It would create a whole square of houses, one of our cable railway lines, or several great factories, still his unfortunate fate may, outside of his few friends, pass into oblivion before these words are printed. Mr. Cornell was a native of Maine, 60 years old, and long a resident here.

Mr. Wm. A. Doble, whose experiments in steel endurance we noticed last month, has continued them by having 24,000 blows with eight-pound sledges, struck on the end of a piece of Firth steel, 1½ inches square, and 8 inches long. The piece was secured as before, in an anvil or heavy casting, and the time consumed was 4½ hours, with relays of men. The piece, which is now at hand, is not sunk on the end more than one sixteenth of an inch. It is not split or spawled, indeed seems to have received but little punishment. Mr. Doble's opinion is that at a certain temper or hardness, good cast steel assumes qualities of elasticity, hardness, and coherence that makes it almost indestructible by blows. The problem has a bearing on armor plates, not new perhaps, but unsettled.

The Vulcan Iron Works of this City, have constructed in British Columbia, a plant for freezing Salmon, that is, if we mistake not, the first of an important industry for this Coast. There is often congestion of the salmon packing industry, but if fresh salmon can be frozen and transported across the continent, there is then no limit except that imposed by closed seasons and the amount of fish. Mr. Graham, the manager of the Vulcan Iron Works, informs us that the Salmon on being taken are first exposed to temperature of 12 or 20 degrees, and after seven hours, to another room with a temperature of 30 degrees or 2 below freezing, where they remain for ten days or more, and then are sealed up in cases for shipment and will keep for years. This is the account received, and supposing it to be correct, it will seem that the conservation of the fish is a cheap process compared to the usual one of canning, and the possibilities of the trade are vastly increased by means of storing fish as fast as caught, when there is a heavy run of them.

Mr. J. M. Thompson, C. E., of this City, has assumed the management of the San Francisco branch of the Westinghouse Electric Manufacturing Company, the office of which, has been established in the new Crocker Building. This business covers the various branches of power transmission, electric railways, lighting plants, and supplies pertaining to electrical apparatus of all kinds. The great companies are now well represented here, and were it not for the general depression in business on this Coast, would be supplying in excess of what the population indicates. The time will come when the employment of electricity here, will exceed, in proportion to the number of people, any other part of this country. The physical conditions and circumstances favor it, and the present is a good time to "get ready."

A mine in Shasta County, this State, has been fitted up with an aerial line for conveying ore and wood, with a result that is surprising. Mr. James Barron, C. E., the manager, in writing to the Vulcan Works here, who erected the plant, says: "The saving effected by the ropeway is $900 a week, and at the rate of $40,000 a year of running time. The rate of hauling ore by teams, was $2.50 per ton, now it is 12½ cents a ton. Wood that previously cost $5.00 per cord is now delivered at $3.00 a cord." There are cases enough of this kind throughout the mountain regions of California, to call for hundreds of these rope lines, not only for ore and fuel, but other things. Mr. Graham, the manager of the Vulcan Iron Works, informs us that he is now constructing a line to convey wheat in sacks at the rate of 80 tons in ten hours a distance of 6,250 feet with a descent of 1,920 feet. Some further particulars of this line will be given next month. Not only are there opportunities for cheapening transportation at existing mines and works, but like electric transmission of power, the system often permits the construction of reduction works in advantageous positions for water power, but inaccessible to teams or railways.

COMMENTS.

From the late act of the Senate appointing a standing committee on a National University, and from other sources one may see at last some conception of training young men to politics or statecraft, outside of the "law" and independent of what we call practical politics, meaning thereby the chicanery, deceit and even ignorance that now attaches to that calling in its lowest phases. It is about time something was done. The term "politician" has become one of reproach, and the word so besmeared that it seems necessary to hunt up a new one for members of a trained civil service. It will take a long time to work a change, because people look on "office" as a public favor to be dispensed among the people, irrespective of qualification, or nearly so. The result is not unlike selling or giving a man a diploma or degree in any profession, because it was his turn for a favor.

A contemporary quotes Aristotle, Ben Franklin and Ben Butler, with other authorities, to show that the value of gold is created by law, and the metal has no more intrinsic value than iron. If this is so, what is the use of procuring it at all? Any other metal properly stamped would do as well. How anyone can entertain such ideas, when they look over a list of paying and non-paying gold mines, it is hard to understand. The fact is, that although one value of gold is in its adaptation for money coins, if that use were wholly suspended the price of gold would not, and could not, fall much below its present rate. There is only half of it now in coins, and the rest, in other uses, is usualy sold far above the coin value.

They are considering, in Paris, an underground system of urban railways to be driven electrically, which, from some recent figuring on the London lines, is not likely to succeed well. If the traffic is any where near what it is in London, there will be required enormous generating plants at short distances. For example, with stations one mile apart, and two trains between, each of 500 horse power, it would call for 1,000 horse power per mile. There is no need, however, in Paris of such frequent trains, and it is doubtful if there is need at all of so expensive a means of transit as an underground railway on the plan of those in London. The streets of Paris are open and free in comparison, and there is seldom conjestion of traffic there, as in many other large cities.

The French bounty of 60 francs a ton for all ships built in France, and 1½ francs per ton for each 1,000 miles run by such ships, has not turned out as expected, but quite the reverse. The Act was for ten years, and expired in 1891. During this time French owners bought more ships in England than at home, and there was no increase in tonnage as expected. A commission of inquiry, recently appointed, has decided that it will take a bounty of 120 francs a ton to cause ships to be built in France. The commission says wages are 50 per cent. more in England, the men work shorter hours, but the builders there offer ships at 50 per cent. less than they cost in France. If, as in this country, the French were prohibited from buying in England, they would simply remove to that country, or sail their ships as British. We think the best thing the French can do is to read Bastiat's Sophistries, and apply some of the lessons taught therein.

Work has again stopped on the Hudson River Tunnel, after various mishaps and failures, financial, mechanical and otherwise. The scheme was treated in the style of our day, that is, it was taken to England where a million and a half of dollars was raised to complete the tunnel, and a contract was let to an English firm of contractors who applied the Greathead shield system, and went on, it seems, successfully until the money ran out, a year ago. The cost of construction is about five hundred dollars a lineal foot, but this would not hinder its completion if the scheme had, from the beginning, been laid down in a proper manner. Now it seems there are no adequate connections at either end, and the tunnel being far advanced, property owners will exact exorbitant prices for land at the approaches, and there are chances of the whole being abandoned.

The riots at Homestead, Pa., are now happily at an end, for the present at least, and people are talking law and order. The whole matter is disgraceful, and began, it seems, with the fortification of the Carnegie works, which were surrounded by a stockade, loop-holed and fitted with hot-water pipes. On the top were strung lines of wire to be electrically charged. A tower was built on which was placed a search light, with photographic apparatus to catch the battle. This extraordinary proceeding, which we understand preceded the lockout or strike, was, to the men, an exasperating declaration of war, and was also an insult to the laws and civil power of this country. It was tantamount to saying the company had no regard for, or confidence in, the "laws," which are now a matter of so much solicitude. The men met this gauge of battle by war, murder, and the abuse of unarmed men. The nature of the strike has been discussed quite enough, but the moral it affords can furnish material for some useful thought for the future. The pressure on prices of steel at Pittsburg, if there be a pressure, which is to be doubted, comes from competition with the southern steel and iron companies, and is not to be got rid of by cutting down wages. It comes from overproduction, and that from overstimulating an industry, which, by all accounts, far exceeds in capacity what the country requires. Steel, no doubt, is cheap relatively; every element that enters into it is dear. Wages, if we are to believe the reports of the U. S. Labor Commission is the least inflated of all, and the fear is that we are not yet at the end of disturbance in this great industry.

The *Engineer*, London, comes with its first article, another "Battle of Dorking," but this time laid on the seas, and an imaginable war with France is the theme. This appeal to the savage passions of people is a sensational method of treating such subjects, appealing to what they call there the "jingo spirit," and if we may be allowed an opinion, is much out of place in our able contemporary. The publication of such a thing at this time has some political significance, no doubt, and is a ruse such as is becoming too common in English politics, especially on the Tory side. They delighted the heart of Lord Beaconsfield, and one had hoped were buried with that erratic statesman. The present matter should have appeared as a "penny dreadful."

If there is any kind of reading thoroughly useless it is accounts of the "decadence" and misfortunes of other countries. The taste for this kind of twaddle is born of a desire to see others unfortunate; a kind of malevolence that sometimes passes for patriotism, and is born of the old mercantile theory, that one country gains what another one loses. The decadence of England, for example, is a theme as old as living memory can run back. It is continually going on in trade, politically and otherwise, if we can believe the gloomy accounts that are given. France, Germany, Russia, indeed all countries, come in for a share in this "decadence." It is a poor humbug, and untrue of nearly every country in the world that is engaged in common manufactures and agriculture, and not engaged in war.

Speaking of the cost of fuel, and the schemes that interfere with its price, we were, some years ago, on the upper Monongahela River attempting to gain some insight into those peculiar conditions there that surround labor in that uneasy district. The journey was made on a steamer, which stopped at one of the mines for coal. Two barges were taken in tow, and the culm or fine coal, with which they were loaded, was shoveled off on the steamer's deck. We asked the Captain how much the coal cost. "Seventy-five cents," said he. We followed with another question as to the rate. "Oh," said he, "that is nothing; the seventy-five cents is for the men who float the barges back. The mines are glad to get rid of the slack coal." Stretching away from here, two thousand miles, was open water, in which this coal could be floated in barges, but its price, along the Mississippi Valley, is not governed by the cost of mining and conveyance, but by towing companies and combinations. It is strange that no attempt has been made in the Upper Ohio and Pennsylvania coal districts to convert coal into gas at the mines, and send that into cities and towns within reach. It will be done, no doubt, if the natural-gas supply falls off.

The *Columbia*, U. S. protected cruiser No. 12, launched on the 26th of last month, is a very remarkable vessel to cost $2,725,000. The ship is 400 feet long, 58 feet beam, and to have a draught of 24 feet. The displacement, with an average amount of fuel, is 7,300 tons, but the most extraordinary feature of all is in the power, which is reckoned at 20,500 H. P., capable of propelling the ship at 21 knots an hour. This is the vessel that has been called the "Pirate," "Commerce Destroyer," and so on, and in fact was designed with a view of destroying high-speed merchant vessels in case of war. It would be much better, in our opinion, if the Government had built, instead of the *Columbia*, three merchant steamers, which the money would have provided, and presented or hired them to some mercantile company. We are also of the opinion that the world has arrived at that point where great merchant vessels, filled with passengers of all nations, are not legitimate prey for war vessels. At any rate it is to be hoped that the *Columbia* is enough of her class and cost in this or any other country.

Congressman Hall, of Minnesota, who is engaged in the manufacture of stone ware at Red Wing in his state, and has astonished his fellow Congressmen by explaining how the labor cost of stone ware was about 40 per cent. less in Red Wing than in Rutherglen, in England, where the same business is extensively carried on. In the case of the larger vessels, those of six gallons for example, the difference was nearly two to one. Mr. Hall, at the same time, called attention to the report of the Hon. James G. Blaine, when Secretary of State in 1881, in which he said: "Undoubtably the inequality in the wages of English and American operatives is more than equalized by the greater efficiency of the latter, and their longer hours of labor." We doubt if, in any case, wages are much higher in one country than another, in so far as the amount paid for production. The "rate" of wages does not amount to much, except as a measure of efficiency. The main questions are: How much is paid in certain countries to perform a certain work, and how much will the wages buy?

The President of the United States having appointed Senator Jones, of Nevada, as one of the delegates to the proposed international, Monetary Conference, is, we think, by no means a promising fact in connection with that assemblage if it ever meets. What Mr. Jones may know of the nature and science of money we do not judge, but if the Conference is to consider means of "extracting it," without returning an equivalent, he will be a well qualified member for that branch of inquiry. A difficulty may arise by other members refusing to endorse his methods of acquiring money, and it might be well to appoint his partners, Messrs. Hayward and Hobart also, to keep him company, and to assist in representing that which will, no doubt, be his chief distinction in an international monetary conference.

The past and present seasons have been scourged by storms, floods and fires, to an extent that will make them memorable, especially if as now seems probable, an epidemic of disease follows on the heels of casualties that have no parallel. The floods and storms in the Eastern States, at a season when such things are not expected, seem hardly reconcilable with the natural recurrence of such things, and must call out renewed efforts on the engineering profession in planning resistance and security against such calamities. The Mississippi valley is too vast to be dealt with, even under the assumption that its sediment must be carried out to sea, which is certainly a mistake. Other smaller streams may be successfully dealt with, or people may be kept out of their way. The fires in cities, of which there have been a surprising number, must recur in wooden-built and wooden-covered districts. Even such carefully regulated old cities as Christiana, Norway, and St. Johns, New Brunswick, are not safe from destruction.

We are fast, but not quite fast enough, in finding out that heat is money. The fact is, that if this commodity could be divided up into parts stamped and weighed, as gold and silver is, it would become a very stable basis of values. The base to which all values, including gold itself, are referred, is labor, sometimes wheat, and other things, but unless a new medium of motive power is discovered, heat will be in the future the most permanent standard for values that we will have. It is true, that in a popular way the value in heat is not thought of, unless it be in the way of fuel—coal, wood, petroleum, and so on, all of which tend to an uniform price on the basis of their heat-producing power. When converted to power, heat becomes a tangible commodity, dealt with at a price, and at a very constant price, varying with the cost of fuel. This variation, as it now exists, is one of the wonders of our time, showing as it does the success with which the currents of trade can be impeded by commercial schemes. For example, here in San Francisco coal is eight dollars a ton, when it ought to be five dollars or less; and petroleum costs much less than coal, when it ought to cost more.

A modern war ship is becoming a veritable machine works. Admiral Sollani, of the Italian Navy, has been casting up the steam engines on a modern battle ship, and finds "sixty-nine" of them, and the total power of auxiliaries, to be 2,500 H. P. for a ship of the *Re Umberto* class. There are twenty different departments requiring separate steam power. In a recent article, published in a foreign journal, there is a question raised whether one of these "machine works" is capable of battle, and the functions intended; and whether a modern war ship is a war ship at all, and suggests that some engineer will contrive one some day that, like Ericsson's *Monitor*, can proceed to fight a whole navy of these complicated machine works.

It has been the province of this Journal to point out, at various times, the part that our antiquated navigation laws have had in destroying American deep-water shipping. To other incongruities and inexplainable provisions of these laws can be added those of redress for the abuse of men at sea. In this port there is from five to ten times a year, a cry respecting the mistreatment of men at sea, and the usual newspaper verdict, with hints of San Quentin for brutal mates, but it ends in talk, the fact being that there is not, under the laws, any practicable method of procedure such as applies in the case of offenses committed on the land. Men that have been abused have to apply "personally" to the U. S. District Attorney, and if a case is made out so as to be unavoidable, the defendant is arrested and at once bailed out, while the complainant is "sent to jail as a witness." There he may lie for six months with other witnesses cited. This state of affairs is anomalous, and is outrageous, indicating the inefficiency of criminal laws and their inability to cope with circumstances at sea. Our marine service is degraded in this way, and the less there is of it the greater the abuses. Some member of Congress, who wants to be famous as well as just, should take up this matter and follow it to a reform.

The phylloxera is slowly but industriously making its way up the California valleys, destroying vineyards that a few years ago gave promise of permanent independence to their owners. It is dispiriting to go up the Napa Valley, for example, and see what a large share of the vines are abandoned to weeds and not cultivated. It is true the land remains, and has capabilities of many kinds; also true that in France one half the whole viticulturist interest was destroyed, if that is consolation, but it is evident that vine culture of the kind now in vogue must leave the sedimentary lands some time. It is the insidious and small agencies in nature that defy the efforts of human knowledge and skill. Large animal and vegetable growths are attacked and destroyed, or turned to useful service, but the vegetable parasite defies our power. We dredge out channels, turn the course of rivers, bridge streams and estuaries, but fail ignominiously when the teredo attacks timber structures. The barnacle, phylloxera *et al.*, go on serenely, paying no attention to our great ships of 20,000 horse power, dynamite, or any other of our achievements.

The *Mining Press* says the MacArthur-Forrest Company charge too much royalty for the use of their reduction process. The same proposition applies to nine tenths of all contracts made for patent royalties. One would think the conditions of such agreements were simple enough to be understood, and they are in fact, but those owning patents always overestimate the commercial value of their improvements. With a low royalty the licensee becomes an ally and supports a patent, with a large royalty he becomes an enemy of the patent, and regards it as an incubus on his business. If the product is a common one, as is nearly always the case, a licensee is subjected to a tax, which must be added to the price of the finished article, or rather must be subtracted from the saving effected in production by reason of the invention, and the remainder is commonly about one fourth what a sanguine patentee estimates it to be. Another feature, not always considered, is the competition invited by a high royalty. It sets at work every one acquainted with the business to invent substitutes, or evade the patent. A royalty of five per cent. commonly brings in more money than one of ten per cent.

Industrial Notes.

The Brayton petroleum engine that was brought into notice sixteen years ago, has come to the front again as an economical motor. In the older forms of the engine, the debris of combustion in the cylinder was an impediment that offered much difficulty, in fact, if we remember aright, was the obstacle that prevented an extensive manufacture of the engines. These motors do not "carburet" the petroleum as in the case of modern gasoline or vapor engines. It is sprayed into the cylinder under pressure, atomized it is called, and in a proper volume of air, and burned in suspension, under circumstances that should secure a full economy of the heat. Ignition is performed by an incandescent coil of platinum wire, constantly exposed in the cylinder. The mechanical construction of the engine is good and philosophical.

It is strange, that in cities where their water supply is drawn from rivers flowing through sedimentary plains, so few have sunk wells alongside the river, and thus secured a natural filter for the water. The amount of infiltration is nearly always sufficient, with a moderate area in the wells, and this can be increased if not enough. At Sacramento, for example, if a well were sunk at some distance from the river, and the City supply drawn from that, there would be no "slickens" to contend with. At Peoria, Illinois, the water is drawn from a well of the kind, situated more than a thousand feet from the river, and the infiltration, when the head is seven feet, is at the rate of one foot a minute in the well. The natural form of such wells, is a long narrow pit, or a succession of pits such as are made in this country for irrigating purposes.

There is an increasing want of an efficient water-wheel regulating apparatus, that will maintain a speed uniform enough for operating electric generators. There is but little promise of success in providing one, and the most promising method seems to be to apply a brake capable of offering a resistance equal to the extremes of variation, and lose the power abstracted by the brake. When we have got this far there still remains a wide field for contriving, but one thing is certain, that no control by means of throttling the water will answer; it is too slow. An extreme illustration of this is seen with the great water wheel at Berdan's, Troy, New York. When a bar is started through the rolling mill, and the water turned on the great 60-foot wheel to meet the resistance, there is a race between the iron and the water. If the bar goes through before the load of water reaches the bottom of the great over-shot wheel, the mill "runs away," or did in old times when the wheel was first erected.

Of all machines that perplex both skilled and unskilled, a hydraulic ram has the first place. It will stop without apparent cause, and start with no discernable cause whatever. It will continue to hammer away oblivious to changed conditions of head, weight on valve, or volume of water; at other times it will refuse to go under all conditions supposed to be favorable and encouraging. The intricate part is in what is called "regurgitation" or reaction, that opens the valve and otherwise causes the peculiar "vibratory" motion, it may be called, of the water, and this, so far as we can discern, is the closing of the check valve, causing a reversal of the flow. When the main valve closes, there is delivered a blow with force enough to raise the check valve and eject water through it in proportion to the head, or rather for a period, the length of which is dependent on the resistance of the head. When forces are balanced there is reaction, the check valve closes and sets up in a modified way, a reverse current in the drive pipe, pulling the waste valve open. If not this, then what?

We have seen the *Wetmore*, whale-back steamer, from the side of the dock, which was quite near enough for æsthetic purposes, but these aside, the whole scheme seems to be chimerical. To attain some added carrying capacity, the spar deck is abandoned and housed over, thus taking away what may be called the "administrative" part of the ship, with no corresponding advantage. Nearly all the work on a ship is performed on her deck. Here is carried and operated her tackle of all kinds, and to say this must be abandoned to obtain an inclined freeboard, seems poor engineering and lack of common sense. Below water there is gained, no doubt, something in carrying capacity, and certainly ought to be, to compensate for what is lost above water, not in appearance only, but in utility and convenience. It is a barge, but not a "ship," and we predict will become a "tradition," instead of a success, in so far as performing the functions of a ship for deep water service. There is on the Mississippi and its tributaries, a class of vessels that excel even the whale-backs in the objects to which the latter seem to be directed. The vessels alluded to are called "flat-boats."

If Mr. Charles Wye Williams, formerly chief engineer of the Dublin Steam Packet Company, who died many years ago, was to return to life, he would be flattered to find that after about thirty years his recommendations and inventions relating to introducing air at the bridge walls of steam furnaces had been appreciated and adopted. The *Marine Review* says that more than seventy steamers on the Pacific Coast are fitted up with these Williams' bridge walls, according to a patent granted to Mr. E. W. Tucker, in 1887, but if there is any feature not included in the Williams' methods we fail to see it. At any rate it will be a matter of interest to those concerned if they will procure a copy of *The Combustion of Coal and the Consumption of Smoke*, one of Weales' series, published about thirty years ago, but recently revised by Mr. D. K. Clarke, and study there the philosophy and principles involved in the method. The book costs about two dollars, and is worth, we imagine, about one hundred times that much to anyone owning a steam furnace.

In a recent letter from Mr. Ralph Bagaley, Treasurer and Business Manager of the Westinghouse Machine Co. at Pittsburgh, he says:

"It may interest you to know that we have just completed a splendid new brick erecting shop and testing department, 50 × 264 feet, fitted with new permanent foundations, a convenient and adequate system of piping, large condensers; two 10-ton, 45-foot 6-inch over-head, Morgan Engineering Co. cranes, etc. Our production has always been clogged in the erecting and testing departments, and with these fine improvements we will be enabled to set up and erect two rows of engines at once, instead of one as heretofore, and we will also be able to test three or four times as many engines. We have also thrown out our old locomotive boilers, which you will doubtless remember, and replaced the same with two very large Babcock & Wilcox boilers, fitted with Roney mechanical stokers, etc. This enables us to test our largest compound engines up to the highest prevailing steam pressures, which we have never been able to do, excepting after the engines had been placed in position for actual work. We are also now building a line of compound engines up to more than 750 horse power, at 150 pounds steam pressure, the cylinder dimensions of our largest size now, being 23 and 40 by 20 inches."

Miscellaneous.

Glasgow is to be fitted with a high pressure water system the same as several other English cities, but with the difference that the city itself will put down the plant. There are 93 hydraulic presses and 508 elevators there that can be operated, and a revenue is almost certain under good management. Glasgow in so far as corporate management, is the best governed large city in the world ; and is also one of the hardest to govern.

At the last meeting of the American Institute of Mining Engineers there was given a description of a new telescope for stadia work, in which the cross lines are omitted, and instead, there is a prism to cover one half the objective. This causes a double set of targets to be seen, and by adjusting the relation of the targets, real and optical, they assume a position constant to the distance from the observer to the rod. The advantages set forth are such as should engage the attention of civil engineers.

There has been recently built by a firm in Savanna, Italy, a very strange kind of vessel, 28 feet long, 6½ feet broad, and 10 feet deep—a kind of "iron fish," so to call it, provided with an electric motor for propulsion. It is intended for submarine work, salvage and so on, and is provided with a kind of water-lock door in the side, through which divers can go out and in. It is intended that the supply of air and other necessaries will serve the crew for two days beneath the watei, if that should be necessary.

Mr. P. Willans, of Willans & Robinson, makers of single-acting engines, was killed some months ago by being thrown from a carriage or cart, in which he was riding. Mr. Willans, next to Mr. H. H. Westinghouse, in this country has been foremost in developing single-acting engines. Both are steam engineers of high rank, and neither were schemers after novelty. From personal acquaintance with Mr Westinghouse, and from being in England when Mr. Willans began his experiments, which were watched with interest, we much doubt if there are many improvements in steam engines that have come through abler hands.

The Lehigh and Wilksbarre Coal Co., at Ashbury, Pa., are sinking a shaft of unusual dimensions. It is 30 × 70 feet and 1,000 feet deep. It will be divided into four compartments for hoisting coal. The anthracite operations in Pennsylvania are enormous. In the case above, this new shaft, it is reported, will add work for 1,500 more men above and below ground.

Arrangements have been made for lighting a line of omnibuses in London by electric lamps fed from storage cells, which is no doubt one extreme of electric lighting. The apparatus consists of a five-cell battery at ten volts pressure, good for a period of twelve to fifteen hours. The mystery is how the electrodes are held in an omnibus with all its rattling and jar. We have done a good deal of riding in London on omnibuses, and were not aware that lighting them was essential, at least don't remember of there being much light in them.

There is a reported purchase by Eastern iron men, of a district in Mexico, 150 miles from El Paso, in the Hanover Valley. The purchase includes a large number of mines, and is valued at from 15 to 20 millions of dollars. The object is to make Bessemer steel, and the works, whatever they are, will be erected in Mexico. The Mexicans, some time ago, wisely removed trade restrictions of various kinds, and if that policy had been pursued farther, it would have attracted capital and enterprise, now however, there is a scheme to tax ore, that may cause a halt in ventures of the kind.

The very laudable attempt made in England some years ago to compel an enrolment of patent agents, is likely to fail of accomplishing all the good intended. It was to protect inventors from incompetent and often wholly irresponsible people who advertise as patent agents there. The profession, to so call it, is in England a very honorable and responsible one, governed by rules the same as apply to the legal profession. Respectable patent agents do not send out circulars and solicit business, but "form a connection" the same as a physician, lawyer or engineer. The Act obliged registry or enrolment, and was in fact a license system, but this looked like a protection idea, for a class, and the courts have found that a person can not be debarred from acting as an agent for another in any matter, and has a right to do so as an "agent" simply, so all there is to do, is to drop the word "patent" and the "fake" agencies can go on with that qualification.

There was recently a railway convention at Buda Pesth, Hungary, in which 113 lines were represented. The purpose was to set schedules for time and charges, which indicates a desirable uniformity of both, and also relations between the companies a good deal more amicable than exist here, or in England. The Austrian lines, amounting to 5,000 miles, are being taken over by the government, and will no doubt all be absorbed in time.

The great Quaker Bridge Dam on the Croton River is again coming to notice. There has been a "water scare" in New York, and this new supply will no doubt be required soon. From the talk, commissions, engravings, maps, and general newspaper reports, most people supposed the great dam was built three years ago; but it is like the towers at Chicago, a paper structure thus far. The Croton River, it is claimed, flows twelve billions of gallons a day, and the new dam, with the old ones, will hold a supply of thirty billions of gallons.

The Westinghouse Machine Company at Pittsburgh, are again extending and will add a new fitting shop to their immense plant. There have been made in the old shop more than 5,000 engines. The new building will be 50 feet wide, 265 feet long and 30 feet high in the clear. This extension is necessary to accommodate increasing business and also provide handling facilities for heavier engines up to 1,000 horse power. The sales of engines for April and May aggregated 6,000 horse power. The limitations of single-acting engines are not yet in view, and notwithstanding all that has been written and said on the subject people are far from understanding them.

Messrs. Priestman, of Hull, England, makers of petroleum engines, have built a launch 36 feet long, which it is said, is to be sent to this country, and it is to be wondered at, if there has been in any way the progress made in the eastern states that there has on this Coast. We must contend that in so far as design Messrs. Priestman have excelled our makers of boat engines, giving them a true marine type and adaptation to the purpose, but in so far as performance, it will be difficult to excel what has been attained in San Francisco by the Union Gas Engine Company, which must now have at least a hundred engines in boats and vessels of various kinds.

The Government works at the mouth of the Columbia River have succeeded in maintaining now about 30 feet of water, which will be increased by the scour in the future. Circumstances point to the successful maintenance of that and other harbor entrances without difficulty or great expense, when the physical circumstances are understood. There is plenty of power and plenty of scour in all entrances to basins or bays, but the action of the water has not until very recently been well understood.

The discussion that has been going on for some months past in England concerning the diameter of pulleys for wire ropes is an example of computation gone mad. The amount written in two journals we will guess to be 30 columns of nonpareil, and it is to be much doubted if there has been anything learned sufficient to pay for the paper printed upon. The data for the future will remain as it was before, based upon the observed circumstances of endurance, and the pulleys be made fifty to one hundred times the diameter of the ropes, or larger.

The Government water storage scheme has subsided, as was predicted in this Journal two years ago. Storing water is no proper function of the Government, any more than manufactures are. It is a private interest affecting only certain people in a certain district and a subject for private enterprise. A good many reservoirs are being made in Utah, and hundreds will follow, just as any other profitable business is founded. It is even questionable whether the "general data" of Government surveys will have much value, or that engineers will pay much attention to such data when reservoirs are to be constructed.

Manufacturers more than other interests follow the center of population, and the removal of large establishments near this center is going on in a regular way. The Grant locomotive works at Chicago, and the Washburn and Moen works at Waukegan, Ill., only two out of a dozen that could be named that have gone westward. The last named company at their works in Waukegan, which are not yet complete, employ 725 men and have an aggregate steam power of 11,000 H. P., mainly for wire drawing, which is a heavy operation. The principal manufacture is fencing wire, and the saving in carriage from Worcester, Mass., where the original works are, has warranted this great establishment on Lake Michigan.

In some changes of one of the London docks to be made soon, the company have concluded to provide for future contingencies by arranging for vessels 700 feet long, the entrances to be 100 feet wide. This sounds strange even now, when the longest vessels do not much exceed 500 feet. It is only a little time since 300 feet was a limit for length. When 50 per cent. was added to this, about fifteen years ago, we thought there was another limit, then came 500, and now 600 is plainly in view, so that the dock people are not extravagant in their plans.

The survey of the *Thetis*, for a cable from San Francisco to Honolulu, has been much more satisfactory than the one gone over by the *Albatros* last year, and is fifty miles shorter. The distance of the last survey is 2,060 miles, and is considered practicable and easy ; the bottom of the sea being smoother and the depth more uniform. What, if any, arrangements are made to command capital for laying a cable, we do not know, but presume it will come up in the form of a private company with a Government subsidy, there being no concession and franchise in the case.

Mr. E. D. Leavitt, the well known engineer of the Calumet and Hecla copper mines, says that formerly it was a custom at the mines to bury and cover in steam pipes under ground without any non-conducting cover, and that the "loss was enormous," but now the pipes are covered with a layer of plaster of Paris and sawdust two and a half inches thick, one part of the plaster to two of the sawdust, and that when so covered condensation nearly ceases, or was only "one hundred to one" of what it had been before. Gypsum and sawdust are both cheap and the plan worth a trial, but we would expect no such effect from its use as above stated.

The New York Central Railway has set out in earnest to equip its main line with the block system as far as Albany and Buffalo. While it might be unfair to compel any but main and prosperous lines to operate their trains on the block system, it is certainly right to do so with such lines as the New York Central, the Pennsylvania and Baltimore lines across Jersey, and wherever there is heavy traffic. The "block" system means simply that the line is all under signals and surveillance, being divided up into "blocks" or sections, into which no train is permitted to enter until the preceding one has passed out.

The Spaniards have several times attempted to construct locomotives, and have not succeeded very well. The labor is cheap enough, of that there is no doubt, but cheap labor — that is, cheap in rate — is apt to produce dear work. An iron company in Spain has successfully made some mineral locomotives, as the English call them, for use in mines, which is at least something toward engine making.

The *Engineer*, London, has got itself into difficulty, we fear, in publishing some letters on gyrascopes. They will probably continue for a tiresome period, because there is latitude for any amount of opinions, theories, and conjectures. It will be easier than the law of forces, and the central all pervading law of motion. There may be within the known laws of physics, sufficient explanation of why a top or a gyrascope keeps to one plane of motion, but it is not easy to convey it to common perception.

The production of gold is continually decreasing, not relatively but absolutely, and its comparative value is at least fixed if not increasing. This is, however, hard to determine, because of the instability of other commodities with which comparison can be made. The total production for 500 years past is estimated at seven hundred millions. The present production is not more than one hundred millions a year. Australia produced one billion, or ten hundred millions. The Persians, in early times, had collected or owned the greater part of the world's store. The Greeks carried off from there five hundred millions worth of the precious metal.

There are twenty boiler explosions listed in the *Locomotive* for April of this year, and of these just one half occurred in saw mills. Assuming that the proportion of steam boilers in saw mills is not more than one in twenty, and that is surely above the mark, there are ten times as many explosions in such mills as in other cases. This points to incompetency as the main cause of such accidents, because saw mill boilers are operated under conditions favorable to "longevity." The fuel is less intense than coal, the pressures employed are low and the boilers usually in plain view and under inspection all the time by people around them. The fact points to the average saw-mill engineer being incompetent.

ELECTRICITY.

DIRECT AND ALTERNATING CURRENTS.

The following is an extract from a recent article by Prof. Elihu Thomson, of the Thomson-Houston Co.

"Let it be desired to transmit several thousand horse power from a water power to a distance of, say, twenty miles or more, and deliver it at one point as power. What plant should we use? Direct current or alternating current?

Owing to the difficulty of constructing commutators which are suitable for such high potentials as five thousand volts, especially where the current is large, it is evident that neither dynamos nor motors can be used, in which the full potential is either generated or used. This assumes the use of a direct or continuous current as the means of transmission. In such case, either the voltage must be kept down to, say, 1,500 to 2,000 volts, or the dynamos and motors must be run in series sets.

It is questionable whether commutators can be commercially successful on which the pressure exceeds 1,500 to 2,000 volts, with large currents flowing. They are very difficult to construct and to maintain. Besides they require to have so many segments between the brushes that the armature winding and connecting is made more delicate, and liable to injury. The cost of construction becomes excessive. When the voltage does not exceed 1,000 volts these difficulties do not present themselves. Hence to use continuous currents in the case assumed, and to take advantage of a high line potential to secure immunity from line losses and allow a moderate outlay in copper to suffice for the transmission, it will be necessary to connect several dynamos in series in the generating station, and several motors in series at the receiving station. These machines may be belted to a common shaft. With this arrangement it would be possible, by mounting the machines on insulating bases, to work with such high potential as 20,000 volts by having twenty machines of 1,000 volts each, connected in series at each end of the line. This with each machine of 5,000 watts output would transfer energy at the rate of 16,000 horse power."

It is becoming evident that the future of electrical development will be especially in the way of power transmission, and perhaps power generating. Lighting, the conduction of writings and speech, and application in the manufacturing arts, are much more nearly perfected than what may be called the dynamic branches of the subject. This latter has called into the research a very high class of talent, and is no doubt at this time engrossing Prof. Thomson's attention.

NOTES.

One of the most remarkable essays on electrical science that can be referred to is an able paper on *Recent Progress in Electricity*, prepared and read by Mr. E. J. Molera, of San Francisco, before the Technical Society of the Pacific Coast, at the beginning of 1885, nearly eight years ago. Although electricity is but one of many branches of sciences to which Mr. Molera gives attention, an examination of the paper in question will show that his consideration of the subject included a remarkable prognosis of what has since taken place. The paper is divided into sections embracing different branches, and was ostensibly a resumé of the progress of the preceding year (1884), but, as before said, it reaches far into the future. For example, respecting the transmission of power for one thing, he said:

"There is no doubt that, in the near future, currents of many thousand volts will be used, and by their means the cheap transmission of energy will be accomplished. Nothing has been done in this country in this department."

In connection with this is mentioned transforming to a lower voltage, and it must be remembered that at that time, and for long after, there was no application of high voltage and transformers such as is here shadowed forth. The paper is full of similar prognostications, since verified.

The Short Electric Railway Company, it is reported, have made a definite proposal to drive the trains of the Manhattan Overhead Railway Company, at New York, by means of electric motors, and could, no doubt, succeed, at least the Short Company are the best judges respecting the practicability of such an undertaking. Judging from the circumstances there is, with one exception, more in favor of electrical driving on these overhead lines than with those on the ground. The exception is in starting the heavier trains when loaded, but this, we imagine, the Short Company proposed to provide for by differential gearing. There may also be impediments of adaptation, but these can be overcome, and, if economical, we think the Manhattan Co. had better try the plan. The conductors, if overhead, would be more out of the way, and safer than in the case of common street car lines.

The City and South London Electric Railway have two armatures on each locomotive, having a torsional force or torque of 1,500 pounds, and equal to a running power of 100 horse power, but this, as the editor of the *Engineer* points out, is not a "starting" force but a working one, and that a "static torque" to meet the requirements of the traffic on a heavy line would call for something quite different. A geared dynamo running all the time during stops, at its normal speed, and clutched to the axles by friction gearing, would be a theoretical plan, but not a very practical one in the light of past experience. If, however, the power is there, means of its application will not long be delayed.

A St. Louis judge has decided that theft of an electric current is not stealing, a decision, no doubt, inspired by the Treasury one of some years ago that electricity was an intangible substance, and hence not subject to a custom's tax. Both of these rulings reminds one of the English railway porter who decided that "rabbits were dogs, and must go in the van; but terrapins was insects, and could be carried by a passenger." We imagine that either the judge or the Treasury official would think electricity a substance, or at least a taxable and tangible commodity, if they had to pay, each month, for a given number of amperes, duly delivered and set forth in a cash invoice from an electric company.

MINING.

THE DEBRIS LAWS.

While it must be admitted that the resolutions adopted by the anti-debris convention at Sacramento, in June, are extreme, and in view of preceding facts open to criticism, it must be remembered that their spirit is in great degree a sequence of the high water this year in the "middle river," and the serious danger incurred by a large number of people. Without venturing upon any positive opinion in this much disputed problem, it is to be doubted if legislation or special laws has done any good in the case, and whether it would not have been much better to have depended on the regular statutes respecting damage to property. One special law always demands another, and both require amendments. It is a pernicious system, without end, and one that has never succeeded in any good result. The organic laws relating to the protection of property are centuries old, and should apply in any and all cases. The idea of appealing to the Government for special acts and aid, to be promoted by delegates, petitions, and worse, is the curse of our present political system, and in the present case we venture the opinion that if suits had been brought in the Federal courts on a plea of impeded navigation, or in the State courts for damages to lands, there would have been a much fairer issue, costing in the end less time and money than the Debris Act, and the proposed new law to modify or repeal the first one.

Such suits would have been enormous, no doubt, but would not only have adjudicated the debris question, but would have set up decisions for the future that would perhaps have been a guide through some generations to come. The debris laws, on the contrary, have no value as a precedent, and as before remarked, have led to new efforts for counter legislation, strife, discontent, and law breaking—a common result of meddling with established things.

GOLD EXTRACTION PROCESS.

A patent was granted in England, about a year and a half ago, on the following process for gold extraction. The patent is No. 18,934 of 1890.

"The extraction of gold and other metals from their ores is carried out, according to this invention, by the use of chlorine, bromine, or iodine. A series of vessels are employed arranged in a circle, each vessel being provided with a manhole at the top through which the ore, in a finely divided state, is introduced, and a manhole at the bottom through which the tailings, after the gold has been extracted, is discharged. The upper ends of the vessels are connected to pipes running along above them, each vessel having a stop cock provided. The lower ends are also connected to pipes provided with stop cocks between each vessel. A force pump is provided, connected with the upper pipe, by which a solution of bromine, chlorine, or iodine is forced through the several vessels to a long vertical pipe, where the liquor, with the gold in solution, is discharged. The operation is as follows: The vessels are filled with the ore, and the manholes closed. The stop cocks are so arranged that there is connection only at the bottom between the first and second vessels, at the top between the second and third, and so on through the whole series, the last one being in connection with the vertical pump. The force pump is then started, and the solution is forced, at a pressure of about 100 pounds per square inch, through the whole of the vessels into the pipe, where it passes through a series of filters and is discharged at the top. When the liquor has been flowing for a sufficient time to allow all of the gold being extracted, the liquor is cut off from the first vessel by the stop cock, but continues flowing through the others. The tailings are then withdrawn from the first vessel, which is again charged with ore and connected with the series, but this time becoming the last vessel. The next vessel is then cut off and recharged, and so on for each vessel of the series. The process is thus a continuous one, the liquor being kept continuously flowing. Claim : The extraction of gold from the ore by means of a continuous flow through the finely-divided ore of chlorine solution or other solvent under a pressure of 100 pounds per square inch.''

NOTES.

The Savage Mining Company, at a late meeting of the directors, instructed their superintendent to invite bids for milling the company's ore, and adopted various regulations respecting checks, by inspection and otherwise, to prevent stealing the bullion, but the wisest thing of all was to appoint a committee to confer with these other mines respecting the purchase or building of a mill to reduce the ores of the four mines, the Chollar, Potosi, and Hale and Norcross. One thing is certain, there will be no more extensive stealing of the returns as in the past, unless there is a relapse to a ring, and even that may come about. The want of honesty, and a want of system and organization on the part of the mines, is accountable in a great degree for the decline of the Comstock.

The depth of coal mines in Belgium averages 1,800 feet. Those in France 1,073 feet, but the deeper coal is better, and will soon be sought. At Mons, in Belgium, there is a mine 3,036 feet deep, and coal has been found at more than 4,000 feet deep. Salt mines in Germany have reached 4,175 feet, and coal mines in England over 3,000 feet. The deepest holes drilled are in this country where two wells are reported, one at Wheeling, Va., and one at Potsdam in Missouri, to be over a mile in depth (5,280 feet). Except these cases the most noted deep wells are in Germany, bored by the Government to determine the formation of the earth, and search for minerals, but without finding coal in paying quantities.

The most extensive submarine mines are said to be at Nanaimo, B. C., where the Wellington mine is 600 feet beneath the sea, and the galleries under the water make up six miles of length. This indicates impervious strata, and consequently confined gases. This is a characteristic of the Nanaimo mines, which are, as they say in Wales, very "fiery." Some years ago, it may be remembered, one hundred people were killed at these under-sea mines by an explosion of pent up gases.

In a recent examination in Victoria into the gold mining affairs of that colony, the product per man, or for each mine as it is stated, is a little more than $500, or $1.66 per day for three hundred days in the year. Our friends who contend for a representative value of gold and silver can get a suggestion here, and see that gold is worth what it costs to procure it. There is no doubt whatever that if the total amount of gold, added each year, was charged with all the outlay spent for its procuration, failures as well as successes, it would be found that its present value is less than the producing cost. This is almost certain to be the case, because gold mining is speculative, and enticing for that reason. It is like a lottery, and people will pursue it for less profit than is afforded by other business of a stable kind. There is no need of assuming a mint or stamp value, fixed by law. Like all commodities it is worth the cost of production.

THE CONTROL OF THE NICARAGUA CANAL.

BY CAPTAIN WILLIAM L. MERRY.

How the Nicaragua Canal shall be managed in the interests of commerce and cheap transportation is a question of vital moment to the Pacific Coast, and to the commercial world. Consequently the conditions surrounding the enterprise should be thoroughly understood. While I do not differ from Mr. Manson in regard to the necessity for Government control, I must decline to accept as facts some of his assertions connected therewith.

It is a matter of history that an effort was made by the United States Government during the Arthur administration to construct the canal as a Government work. The Zavalla-Frelinghuysen Treaty, between Nicaragua and the United States, provided for a joint control; construction by the Government of the United States; the right to fortify and garrison the termini; and a joint sovereignty over two and a half miles on each side of the canal. This treaty was ratified by the Government of Nicaragua, and rejected by our Government through the action of President Cleveland, under the presumed influence of his Secretary of State, Mr. Bayard. It is now generally admitted that we should then have accepted the opportunity of building an American canal under Government control, but that opportunity was not then appreciated.

It must be remembered that in the canal question we are dealing with a foreign government, none the less jealous of its sovereignty because weak in a military point of view. What our Government, or any company, can do in Nicaragua as regards the canal depends on the Government of that Republic, fortunately friendly to American interests. Its overtures to our Government having, as before stated, been rejected, we cannot justly blame an association of American citizens for acquiring a concession for the construction of a ship canal, for which one hundred thousand dollars was paid as a guarantee of good faith.

What Mr. Manson writes regarding the Maritime Canal Company of Nicaragua appropriating the expensive surveys of the Uuited States is correct as to fact, but involves nothing objectionable ; on the contrary, the chief engineer of the Company is an officer in the United States service, and at present connected with the Canal Company by permission of the United States Government. No one found fault with the De Lesseps' French Canal Company using the United States Government surveys when the abortive attempt was made at Panama, and the action of the French citizens was not called " an appropriation of what belongs to the Nation." Why should American citizens be accorded any less privilege ? The United States Government, in fact, surveyed eight canal routes across the American Isthmus, and published the reports to the world, freely giving the information without reservation. Private surveys had also been made at various points, and the results published to the world.

The Nicaragua route became the approved canal line by general consent, and would have been adopted by Count De Lesseps had his application to the Government of Nicaragua been entertained. It is thus proven unjust to find fault with an American company for availing itself of the public information acquired by our Government ; on the contrary, it was the correct course to be pursued, and carrying out the intent of the surveys, especially after our Government had elected not to build the canal itself, and rejected the invitation of the Government of Nicaragua to do so.

That the Nicaragua Canal can be made a monopoly if constructed with private capital under the present concession from Nicaragua, and charter from the United States Government, can be easily proven an impossibility. The charter expressly states that it may be amended or rescinded at any time by the Government. The concession expressly states that tolls shall be moderate, and uniform to the commerce of all nations, and a violation of this obligation forfeits the charter. The limit of earnings is placed at 15 per cent. per annum, when tolls must be reduced, and the Suez Canal is now declaring 20 per cent. dividends on a toll of less than $2 per ton.

Should the Company violate its concession by discrimination against American commerce, in collusion with American land transportation systems, the Congress of the United States would necessarily be corrupt to permit it, and the Government of Nicaragua would violate its treaty obligations with the United States to countenance it. Should such an attempt be made on the commerce of Great Britain, or other maritime powers, they would promptly demand of Nicaragua their treaty rights under the "most favored nation" clause. It must be remembered that the Nicaragua Canal is an international work, and not available for monopoly purposes, as domestic State corporations have been.

It is true that the canal is certain to be a very profitable work; equally or more so than the Suez, but its profits depend on its use, and its use depends on cheap tolls. The Suez Canal was opened with tolls at two and a half dollars per ton, and its income has steadily increased with a reduction of tolls, which are now approximately one and three quarters of a dollar per ton. There was no obligation to reduce tolls at Suez: self-interest dictated the policy, as it will do at Nicaragua.

It should be remembered that an inter-oceanic canal is not a transportation company. The facts stated constitute the reason that monopolists of railway transportation do not want the canal; it cannot be controlled in their interest, if it could, telegrams would not occasionally appear in our newspapers that "the canal will never be built."

The comparison of the Nicaragua Canal Construction Company with the "Credit Mobilier" is equally unjust and fallacious. What was the "Credit Mobilier?" A close corporation for railway construction, into which outsiders were not admitted. To obtain additional bonds and land grants, mileage was increased, and contracts were let at extravagant prices for construction ; the personnel of the companies was the same, the intent was fraudulent profits, division and silence. Nothing of this kind can be justly charged to the Construction Company. It is not a close corporation, anyone can buy its stock and bonds, both are freely offered. Its officers are entirely different from the Maritime Canal Company of Nicaragua, chartered by the United States Government. This latter Company has made an honorable contract, open to all parties in interest and to the United States Government, for the construction of the canal, payable in stock and bonds ; and the Construction Company offers these securities for sale, wherewith to secure funds for construction on the best terms obtainable. The Maritime Canal Company is obligated by law to make a yearly report to the United States Government of all its affairs, including the sale of its securities, and the work executed to date. These yearly reports are of record at the office of the Secretary of the Interior at Washington. The Construction Company may make money, friends of the enterprise have a right to expect this ; and those gentlemen who are afraid of another "Credit Mobilier" are respectfully invited to subscribe to its securities, now publicly offered here and elsewhere.

We have thus far alluded only to the particulars of private construction, and may now be permitted a reply to the critics of pending legislation in Congress, which the Canal Company is not endeavoring to influence, as Congress itself has declared through its Committee in the Senate.

The American people demand, in the words of Grant : "an American canal under American control." They were deprived of this by the rejection of the Zavalla-Frelinghuysen treaty, but the canal question is a growing one, and they are more urgent for it today than at any previous period. The proposed bill is the result of the efforts of some of the most able men in Congress, and is as conservatively drawn as possible. It is, in fact, so unfavorable to the Canal Company, that it was accepted with the feeling that it was a hard bargain, if passed. It gives the United States complete control of seven tenths of the capital stock, with voting power, and thus entirely controls the Company and its directory, except one director appointed by Nicaragua. It can purchase all or any part of this capital stock at par, at any time prior to the maturity of the guaranteed bonds ; probably such option to be availed of when the stock has advanced, as at Suez, largely above par. The guaranteed bonds are not issued except as work has been executed, and for its actual value, as stated by a board of United States engineers. appointed by the President. It is a very conservative, careful, and well-considered measure, but, even now, *it may be amended*, and I respectfully suggest that the friends of cheap transportation for the Pacific Coast address themselves to obtaining desirable amendments instead of presenting obstruction to this beneficient project so urgently needed by our people.

The canal will be completed in the near future. There is no doubt of that. The only uncertain features are who will own it when completed, and how long (dependent upon finances) it will take to build it. With a Government guarantee of construction bonds it can be opened in 1897. If the Government does not act to protect the interests of the American people, or if the American people do not freely take the securities of the Company, the canal will become European, probably English property, and worse, still it is altogether probable that the English Government will purchase control of the stock, as was done at Suez, with great profit to itself. England has greater interest in the canal than any nation except the United States, and its Capital is the center of finance, while its commercial policy has been energetic, and generally far sighted.

The Construction Company has thus far expended something over five million dollars, with economy and success, and is now before the American public with a five million bond-loan, intended to keep the enterprise at home until the Government has had full time to avail of the present conditions to acquire control. It was the opinion of ex-secretary Bayard, not however, generaly accepted, that the United States Government cannot, without risk of complications, assume the position assigned to it in the Zavalla-Frelinghuysen treaty, of construction on its own account, with joint sovreignty and military defense. These gentlemen assume that construction by an American corporation is admissable, and the wise course of action, obligating such corporation to such conditions as will secure all necessary advantage to American commercial and political interests.

The Republic of Nicaragua has rights which must be respected. Having failed in obtaining the aid of our Government by treaty, Nicaragua has contracted with the Maritime Canal Company for construction, and has ratified its contract, after the fulfillment of preliminary expenditures on the work. Whether after the rejection of one treaty by our Government, Nicaragua would submit itself to the chances of another, is a doubtful question. She will certainly hold the Maritime Canal Company to its contract, unless the United States Government assumes its responsibilities, and, as above stated, this has, thus far, been declined. There is little doubt that the Canal Company would, at this stage of construction, waive its rights for a fair compensation, and accept the terms of the Zavalla-Frelinghuysen Treaty, for construction by the United States Government direct, but meanwhile its duty is to procure construction as speedily and economicaly as possible. Meanwhile, also, gentlemen who object to the construction of this beneficent work under its present auspices, should provide a better method. The question is in the hands of the United States Government at this time, but probably for a limited period only.

The securities of the Maritime Canal Company of Nicaragua, and of the Nicaragua Canal Construction Company, are offered to the American public without reserve ; there is no close corporation about the management. All American Citizens are asked to own in the canal, and its control is offered to the Government on practically its own terms. Failing in this policy, who shall blame the parties that have already expended millions, from seeking capital abroad? That will, in fact, become their duty. The American people are urging Congress to act on this momentuous question, but Congress moves in such matters, only on compulsion, and it may move too late for American interests. Meanwhile the friends of the Pacific Coast should advocate a practical policy of construction under the best conditions attainable—obstruction because the conditions are not as favorable as could be wished, only delays the day of deliverance from extortionate transportation.

William L. Merry

Chairman Nicaragua Canal Committee of the Chamber of Commerce.

THE TECHNICAL SOCIETY.

This association held their regular meeting for August, on the fifth of last month, at their rooms at 819 Market Street. The following new members were elected :

Edward Lownes, Civil Engineer...... ....Riverside, Cal.
W. H. Sanders, Civil and Hydraulic Engineer......Pomona, Cal.
Wm. Praun, Architect.......................San Francisco, Cal.

Two names were proposed for membership, and referred to the Executive Committee.

Communications were read, from the President to C. R. Mason, the manager of the Byron Hot Springs, and from Mr. Mason, to the Society, relative to a proposed visit of the Technical Society to that well-known resort. Upon motion this matter was referred to the Executive Committee for subsequent action.

A letter was read from Messrs. L. C. Russell and E. A. Rix, members of a committee to draw suitable resolutions of respect in memory of the late member, Andrew J. Fraser. The communication was filed, and the committee granted further time.

Mr. John B. Pitchford, of this City, Mechanical Engineer, and member of the Society, read a paper entitled "Corliss Engines," the discussion of which was postponed until a subsequent meeting.

The second paper read was on the "Efficiency of Hydraulic Passenger Elevators," a report of a comparative test of the hydro-steam and the pumping systems, by Prof. Horace B. Gale, member of the Society. The discussion of this paper was also postponed until the next regular meeting of the Society.

The third paper of the evening was read by Lieutenant Jno. P. Finley, U. S. Army, Chief of Meteorological Service on the Pacific Coast, relating to the general Circulation of the Atmosphere, being a discussion of the paper read at the June meeting by Mr. Marsden Manson. After the reading of the paper Mr. Manson announced that he would submit a part of the discusssion in reply, in time to be published with the paper read by Lieut. Finley.

In view of the discussions above, it is doubtful if a set paper will be read at the next meeting, on September, 2d, as the time will be consumed in discussion, and the meeting one of much interest.

EXTRACTS FROM A NOTEBOOK.

NAVIGATING IN A MEADOW——HANSE TOWNS——OLD CHURCHES AND RELICS.
AN IRREVERENT VIEW——OLD COINS AND CABINET WARE.
HOLLAND AND THE DUTCH.

[BY "TECHNO."]

No. XVII

————————When we got to the foot of the Baltic Ocean. I wonder why it is the "foot?" Our steamer was steered straight into a meadow! Away ahead we could see the chimney of another steamer, crawling through the grass, and at intervals high poles or masts traveling along in the manner of a peripatetic telegraph line. The sight astonished me, "paralyzed" should be the term perhaps, but language is not quite so strong here in this matter of fact old motherland. I looked up my Uncle for an explanation. "This" said he, "is not a case of running in a heavy dew, as Western American steamers are said to, it is only a lagoon, bayou, slough, or to be correct, is the mouth of the River Trave, which maintains a narrow channel out through its delta to the sea. That channel for twenty miles or so meanders through the grass, or "tules" as they call them in California. Those masts you see are on boats, towed by horses, and the contrivance is to clear the towlines over the top of the willows that are planted on the banks of the canal. It is all very simple you see, except the making of the delta and all other things of the kind that require some thousands, five to a hundred thousand years perhaps, to form. This thing of time, Tech, is a queer quantity, you don't know anything about time, that is, you have no conception not founded on years, a lifetime, or the period of history, in fact no one has, except a few scientific men who are for years buried in a fog of archæology, but this has nothing to do with the river. We are heading sou'-west. In a few moments we will be over yonder heading north, then some other way and in an hour or so will come to Lübeck. It is one of the Hanse towns, a member of the Hanseatic League, famous in commercial history, and the subject of various lies as well as a great number of queer truths. You can read it up at your leisure, and believe as much as you please. Lübeck is a wonderful old town that always had an eye to business, down to a century or so ago. They loaned money to the Swedes, who were eternally at war with some of their neighbors, or at home, and of course bankrupt. The Lübeckers exacted usurious interest with collateral security. Once they had a lien on the church bells in Sweden, and took them too, bells were then of more value than at the present time. We can make a good one now-a-days for ten cents a pound, but in those days two or three hundred years ago, they put silver in their bells, and even if they did not, the alloys were worth nearly as much as silver.

Lübeck, after the Hanseatic League, went down as a commercial city. It is in an inconvenient out-of-the-way place as a sea port; put there so the sea robbers could not reach it without some fighting on land, clearing away chains, dams and other obstructions for defense.

Twenty years ago there was good grazing for cows and goats in some of the streets there, but just now there is a new lease of commercial life. Lübeck is alive again."

In time we came through the grass and up to the city, which is in fact, a wonderful old place, very German, very comfortable looking, and fearfully old, to me at least. The churches or cathedrals here (I call all the large ones cathedrals) are of brick of great size, filled with relics, paintings and what not.

I am much afraid of having caught from my Uncle, some of his irreverent ideas in respect to old churches. He says "he would not give a good clean white painted wooden church in America, for the lot." "This old trumpery," he says, "is a coëfficient of superstition, harmless now, interesting and even sacred to many, but that is no reason I must see it in that light. There, is an old chest, made of oak wood bound all over with iron bands, hob nails, rivets and so on. That chest contains valuables belonging to the church, and is itself a relic of much value, that is, value to those who value it, I would not give ten cents for the lot. The iron is worth a cent a pound as scrap, and the oak might make firewood enough to cook a dinner. That is my estimate, but I have no business to thrust my views of the matter on other people, I think, however, it will be safe to suggest to a young man like you to look upon the whole relic matter as a humbug. I have a crack brained relation who labors hard in a machine works to earn money which he pays away for old worm eaten cabinet ware. He is rich and derives pleasure from being thought a "connosieur," as the French say. Perhaps I am a little too utilitarian in these views, because there is to a mechanic, some pleasure in looking at an old machine — that old engine of Watt's, we saw in London, for example, but then an engine is a thing of practical use — a colaborer with men and not the fancy of some old monk who never earned enough money to buy the salt in his porridge.

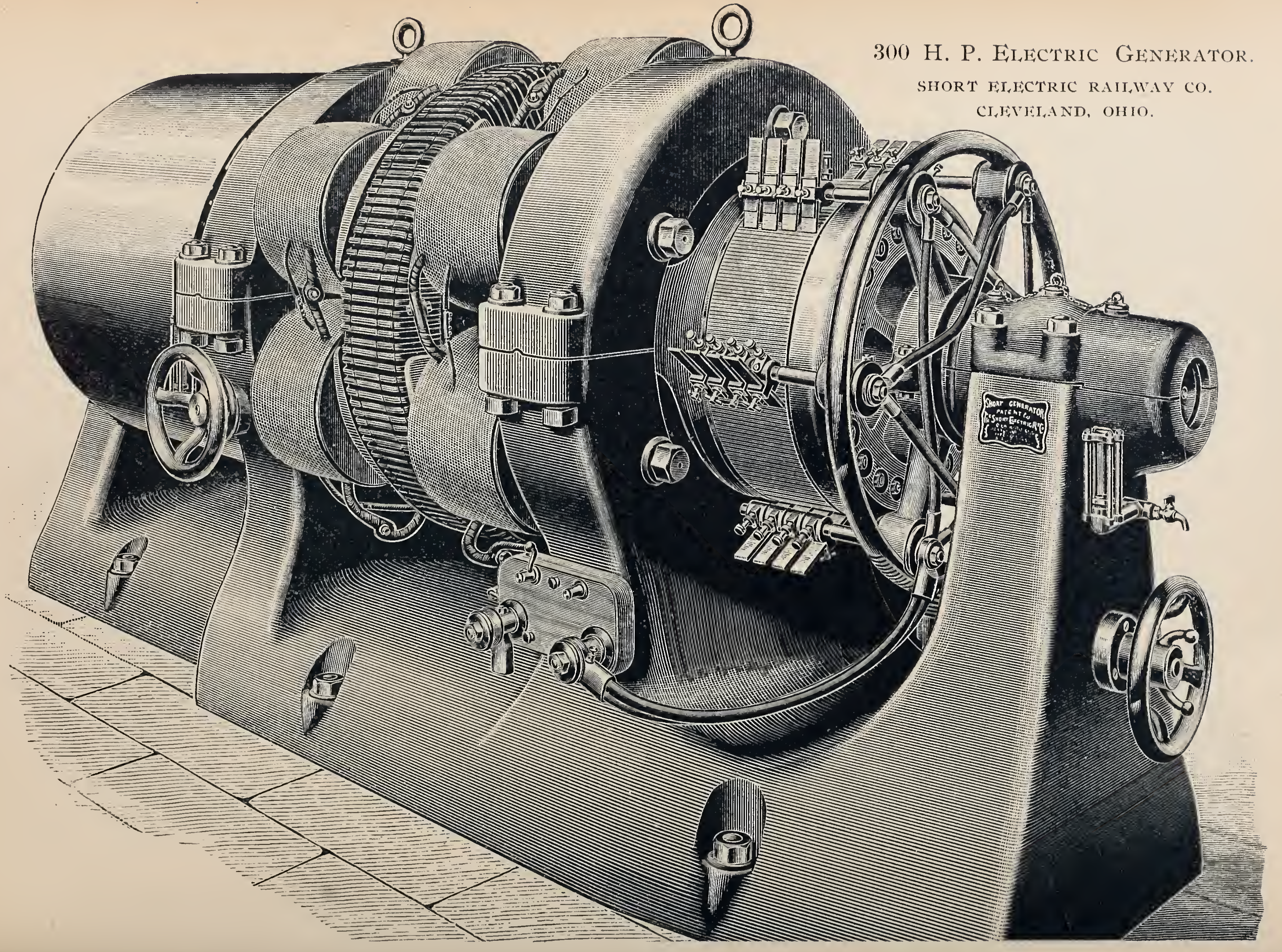
I have another friend who is a coin crank, and I sometimes look with compassion on his collection of badly made old chips — rough, hammered out, some of them, and worth just what the market quotations set down for the metal. He thinks they are old; yes old for the Romans or even the Assyrians or Egyptians to make. For my part a modern coining press has more interest. By the way, just note down in that book of yours, the following proposition: Relic worship is commonly affectation, and a substitute for other information, which the worshiper has not. He tries to hide his defects in a pretended knowledge and admiration for that which is shut out from popular view and thus hides his own deficiencies."

I cannot help in some degree subscribing to these iconoclastic views of my Uncle, but their chief significance at this time is, that our journey will not extend to any of the old countries, nor do I care, that delta of the Trave has knocked the romance of age out of my head. When I want to see something old hereafter, a stone quarry will do. It will be of much more importance to cultivate some reasonable conception of the brief time mankind has been a tenant on this little planet of ours.

There is some machine work done at Lübeck, some ships built, one now and then. Fine Baltic steamers go there. There are no fights, brawls; no crime of any kind to speak of. The laws are supreme and the town is peace. A little Chicago — just a little — infused into Lübeck would improve it, and several large cargoes of Lübeck, sent over to "balance the trade," would much improve Chicago.

———— From here to Hamburg it is only a short way, and unless detained there too long I hope to persuade my Uncle to go to Holland and Belgium before we return to England, Holland anyhow, where I can realize some pleasure from again reading a favorite book of mine, Motley's "Rise of the Dutch Republic,"— a kind of joke in this name, however, because Holland is not a republic, and certainly has not risen, at least not more than ten feet, and is the lowest inhabitable country known, one that has to be "pumped out" as my Uncle calls it. I hope to fill up sundry pages there, if we visit that country.

(*To be Continued.*)



300 H. P. Electric Generator.

SHORT ELECTRIC RAILWAY CO.

CLEVELAND, OHIO.

NEW ELECTRIC GENERATOR.—300 HORSE POWER.

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, OHIO.

The electric dynamo, or electric generator, which seems a more relevant name, has pursued a very constant course of evolution for eight years past, and American designs have, with only a few exceptions, been the leading ones. The progress has all the time been toward a greater symmetry and endurance, with a corresponding gain in electrical functions.

The present design, shown on the opposite page, is one of the latest and best examples of American practice, and this is a considerable claim, because, as before remarked, this country has kept in advance in the mechanical design of dynamos. The practice has, more and more, tended to the massive, plain and convenient. The polygonal field frames, adopted by several makers in Europe, seem to have no object but to coincide with the interior faces to which the magnets were bolted, and for this slight reason are made uncouth and out of harmony with the running parts.

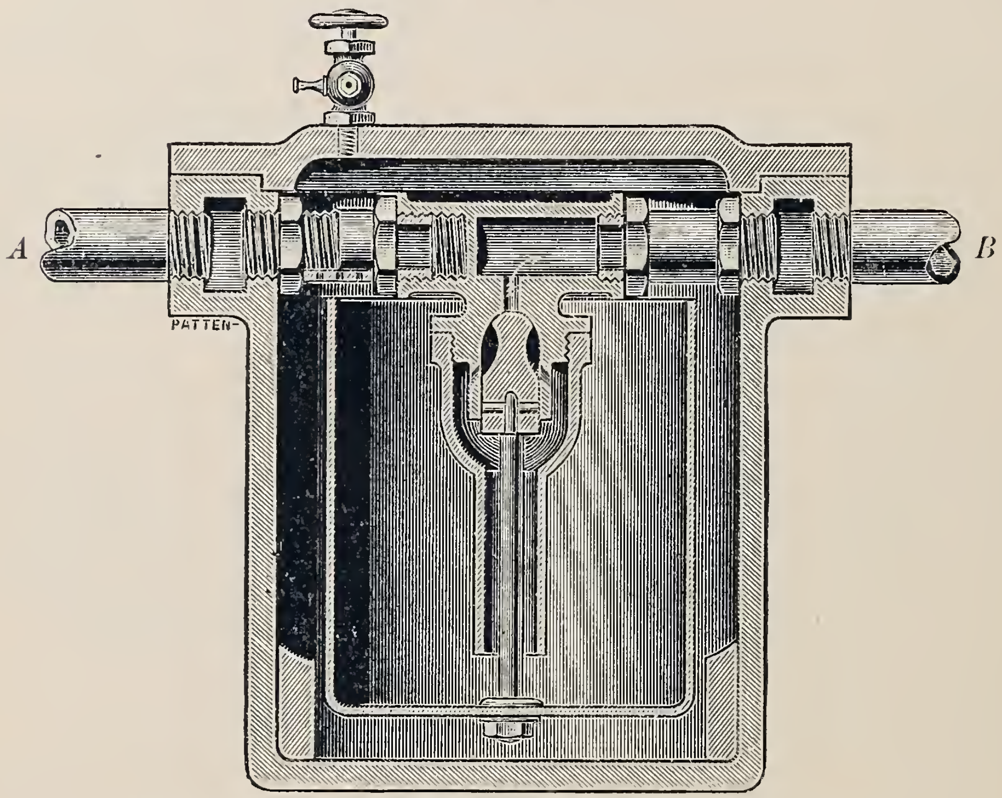
The Short Company's work has, since the beginning, given evidence of a high grade of designing skill in proportions and appearance, and the present example is no exception. The machine has a capacity of delivering a current of 500 amperes at a pressure of 500 volts, equal dynamically to 300 horse power. The following brief description is sent by the Company :

"The field magnet frame is of a new design, 13 feet in circumferential length, and weighs 10 tons. The field magnets, twelve in number, are bolted to this frame, and are similar in construction to those of the four-pole machine made by the same Company.

The armature is mounted on a shaft 13 feet in length, and is of the well-known ring type made by the Short Company, and is 50 inches in diameter.

The shaft runs in self-oiling and self-centering bearings, the center one being provided with six thrust collars. The seat, in which this bearing runs, is provided with a device by means of which it can be easily adjusted, in the following manner: On the lower half of the box there is cast a feather which moves in a similar groove in the frame, and it is operated by a screw which extends through the frame. This screw is provided with a hand wheel and jam nut, by means of which it can be easily held and adjusted.

The commutator is of very large diameter, being 30 inches, and contains 300 bars. The brushes are six in number, and are carried and adjusted in a novel manner. A split wheel is provided in the lower side of which are gear teeth, which mesh into a pinion mounted on the shaft which extends from the frame. On the outer end of this shaft is a hand wheel and jam nut, by means of which the brushes can be easily and quickly adjusted, and held. The generator is designed to run at 300 revolutions when driven by a band, and 250 revolutions when connected directly to an engine."



McKELLAR'S IMPROVED STEAM TRAP.

W. T. GARRATT & CO., SAN FRANCISCO.

"Chordal," in one of his witty articles, suggested that some one be sent out into the world to hunt up a well designed boiler front. He might have made the same suggestion respecting steam traps. These have been produced in all possible forms, at prices from five to a hundred dollars; each of which is supposed to be better than some other, or all others. The result is that while some progress has all the time been made toward a final design, very few of the devices have been satisfactory, perhaps none at all if one "goes out into the world" to inquire.

Mr. John McKellar, of this City, who is an experienced engineer, and consequently should understand the nature of such apparatus, has invented and patented the steam trap shown in the sectional drawing above, which, so far as we can see, comprehends all the known and necessary functions of a steam trap, with a great many structual and operative advantages, and without any pins, levers, working joints, or other contrivance subject to wear or derangement.

The drawing shows all the various parts in so clear a manner that description is almost unnecessary. It may be noticed, however, that the cover is free of all connections or working parts, and may be removed at a minute's time, also that all the operating parts are suspended on the cross-pipe at the top, and these too can be removed, exchanged, or replaced in a few minutes.

Water enters at the pipe *A*, and falls through the perforations in the bottom side of the inlet pipe near the top of the float, and when that is filled it sinks, opening the conical pointed valve in the center. Water then flows up through the bell tube, around the valve stem, and through several diagonal aperatures around the top of the valve, and so on out at the waste pipe *B*, as indicated by the arrow. The valve in this position is safe from sediment or dirt.

A large number of these traps are in use, and we are informed they have succeeded to complete satisfaction where other more complicated ones had failed. Messrs. W. T. Garratt & Co. send a very neat descriptive circular relating to them, from which the above engraving is taken.

CUTTING BOARDS.

A very large machine has been made in New York for cutting boards with shearing knives, and having the novelty of a compound movement of the knives—a direct reciprocating or cutting one, transverse to the edge, and a cross movement parallel to the edge to produce a "drawing" cut. The latter seems to be a crank movement, and if so, is open to the objection of being irregular. We have not in this country done nearly so much cutting of the kind as they have in Europe—in France, for example—but for veneers, there was for many years, and is yet perhaps, on Green street in New York, a novel machine for that purpose that performed even better than any we have seen abroad. There was a huge iron table, mounted on two cranks, so that by their coincident revolution the table passed in front of the knives, which were stationary. The logs to be cut were steamed and then fastened on the face of the table. The whole when started went revolving in a great circle, presenting a frightful appearance. There is a good deal to be done yet in the way of cutting boards, but the machinery for the purpose is so expensive that people are deterred from constructing it.

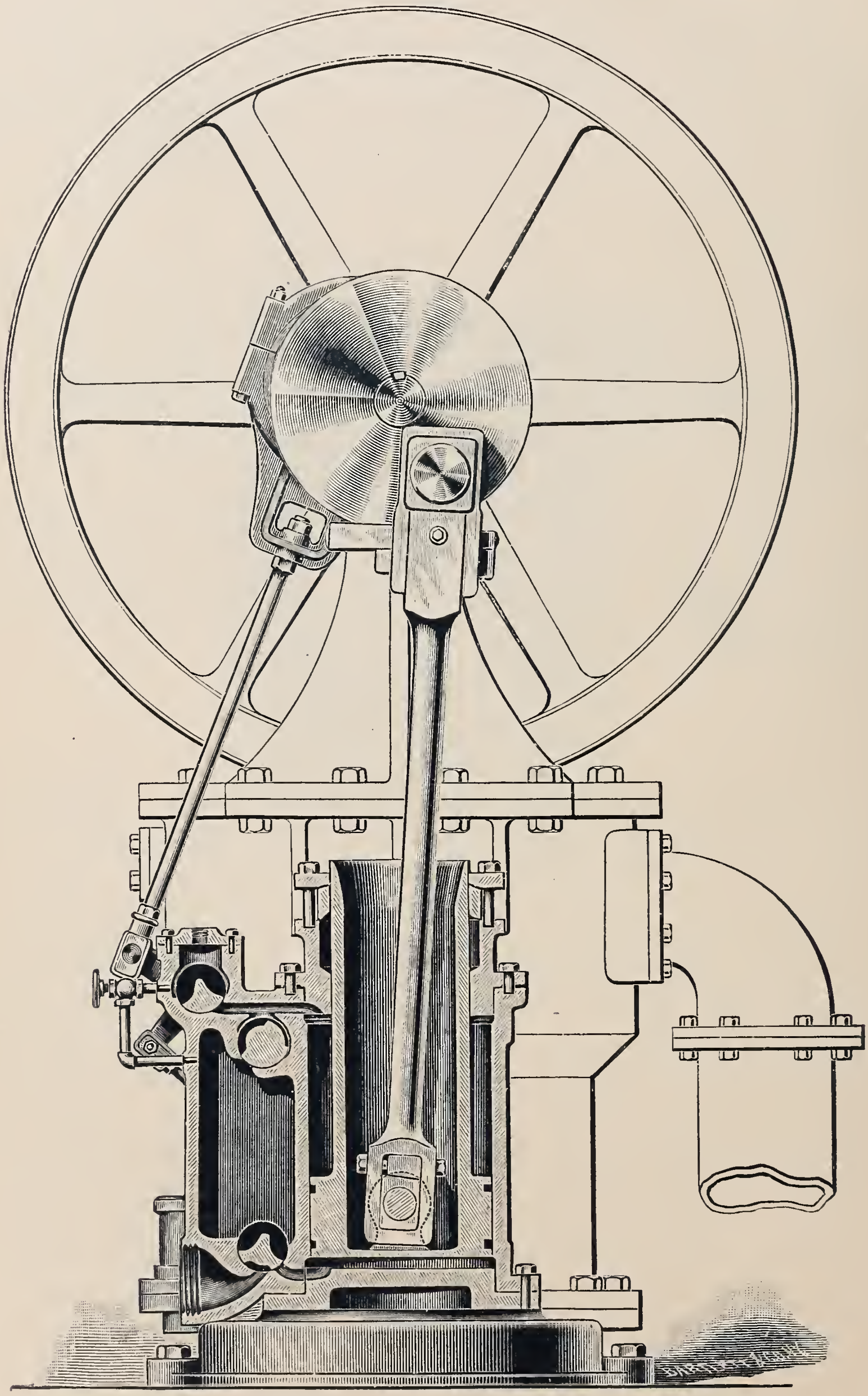


FIG. 2.—SECTION THROUGH THE ENGINE VALVES.

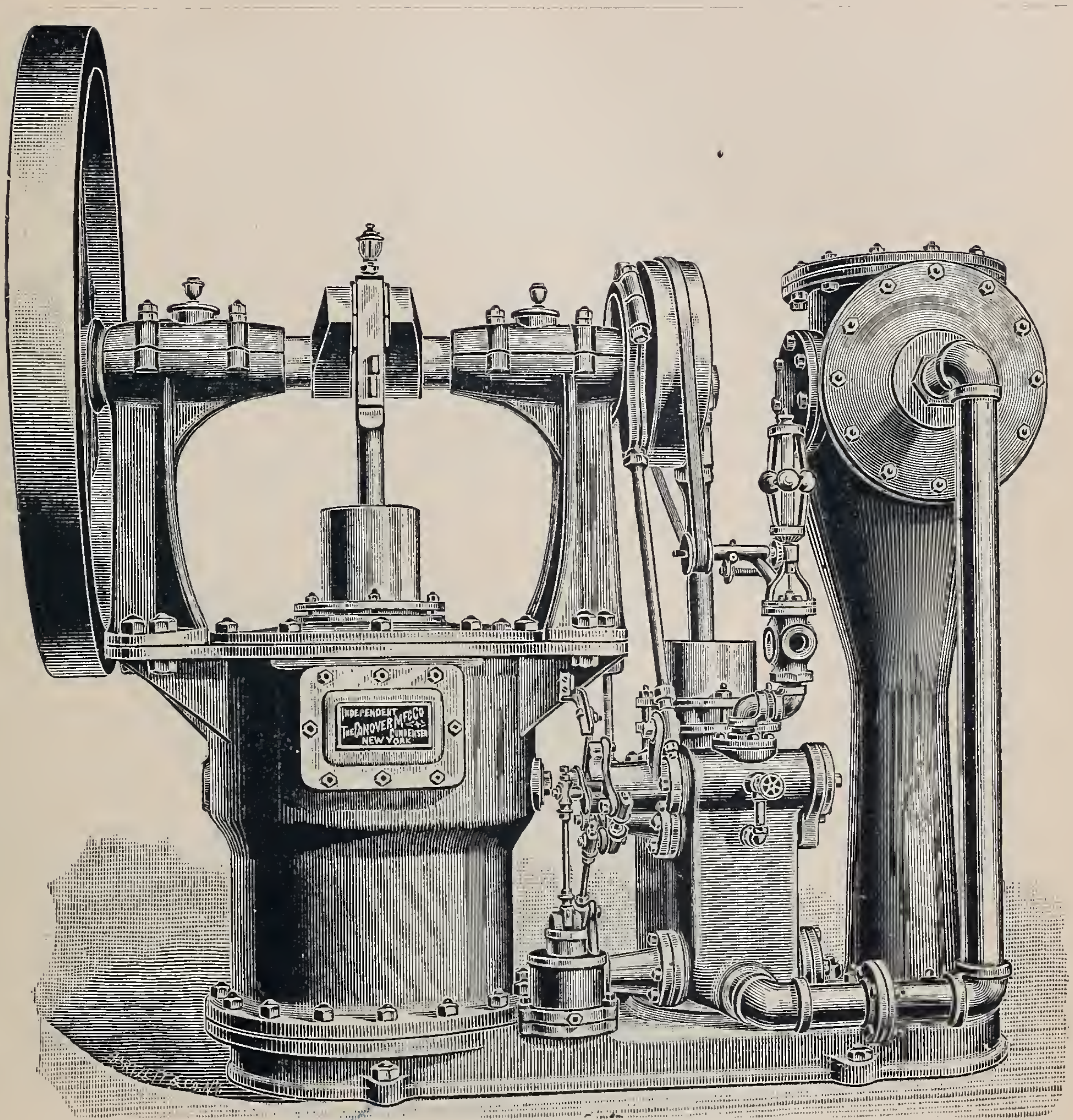


FIG. 1.

INDEPENDENT CONDENSER AND AIR PUMP.

THE CONOVER MFG. CO., NEW YORK.

The Conover Company are entitled to the distinction of having brought to a high state of completeness a class of machinery that has been a good deal neglected in this country. No where else in the world has there been erected so many high-class steam plants of the non-condensing kind, that might have been condensing if original plans had included the necessary apparatus, and in such cases alone, there is a wide field for independent condensers that can be applied to existing plants without change of any permanent parts, and at a moderate expense.

The Conover Company have given independent condensing apparatus especial attention for several years past, and, as the drawings on this and the opposite page will show, have reduced it to a co n plete and symmetrical form to suit for engines of any capacity up to thousands of horse power. The air pumps driven by connected engines, or by belt gearing.

. The engines employed to operate the air pumps, and shown in section Fig. 2, besides being well designed, are a peculiarly ingenious and complete adaptation. The angular velocity of the engine

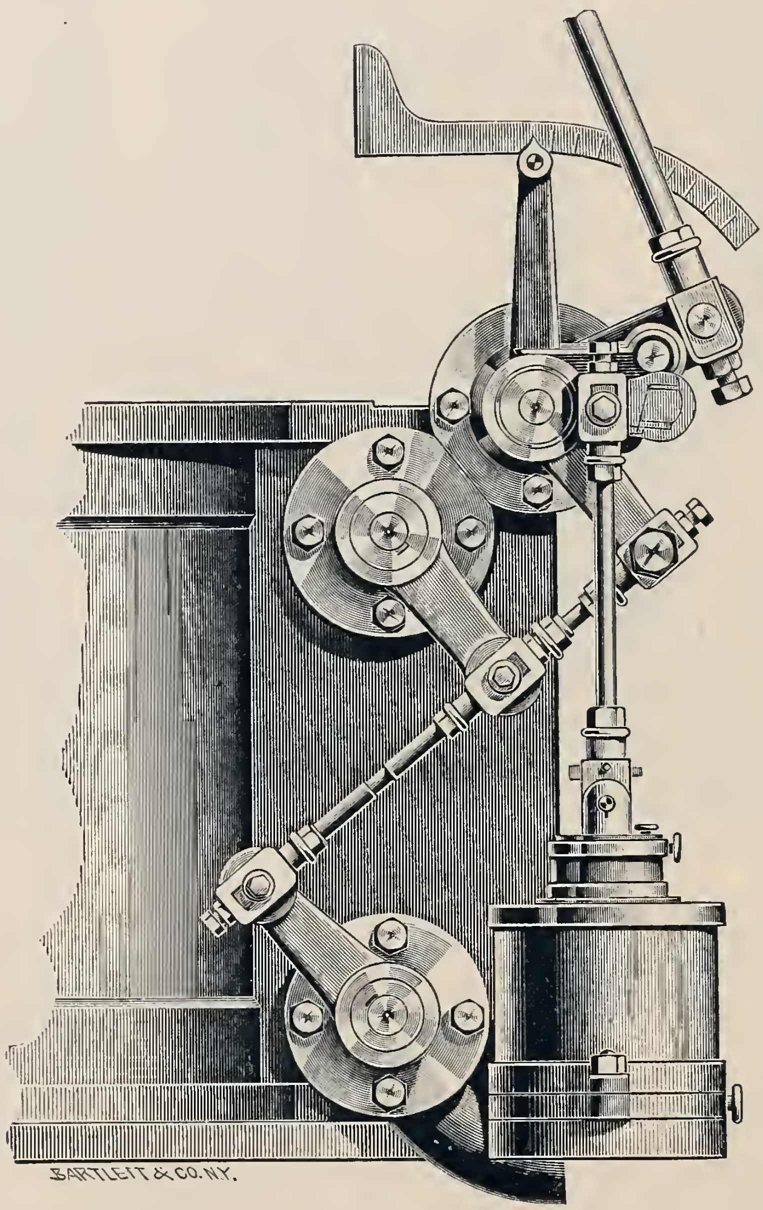


Fig. 3.

and pump cranks are in such relation as balance or equalize the work at all points of the stroke. The engines are of the trunk kind, compounded, and condensing.

The steam from the annulus is discharged into the receiver alongside of the cylinder, and from there acts on the underside, or large area of the piston for the up stroke, reaching a low degree of expansion, and offering a large piston area to the condenser for the down stroke. Steam distribution is performed by a set of ingeniously connected oscillating valves of the Corliss type, with adjustable cut-off gearing and dash pot, as shown.

The Company send the following descriptive matter:

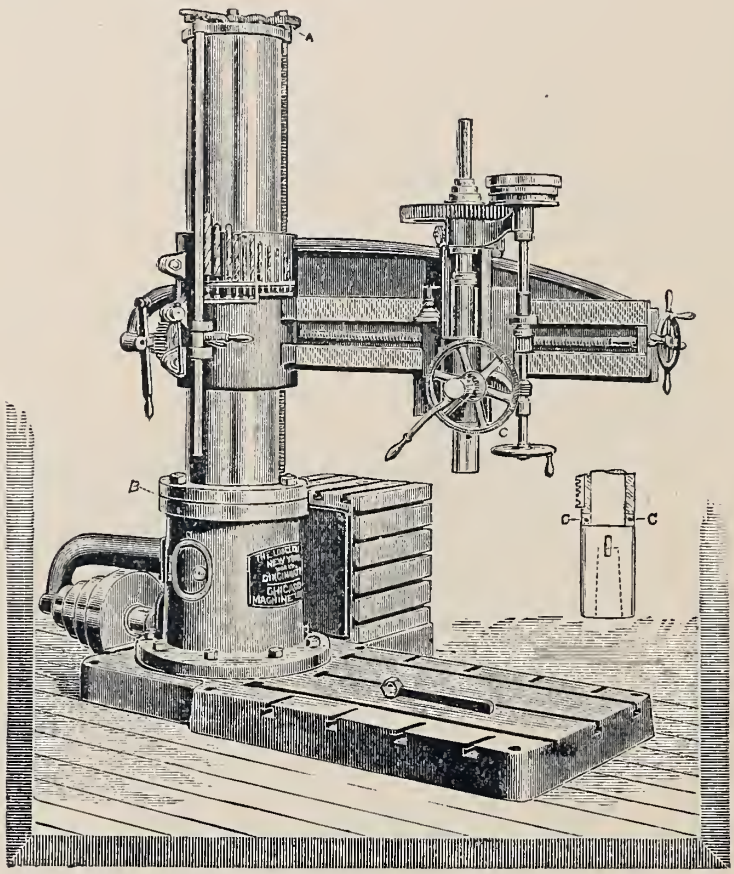
"The many advantages pertaining to the independent condenser, in permitting of adjustment to the varying requirements of the conditions, its relief of the main engine from encumbering mechanism, etc., have been too often discussed, and are too well known to need enumeration here. The Conover Manufacturing Company have made the independent condenser a special study, and have brought it to a degree of refinement which warrants especial attention in these columns.

The condenser under consideration has been designed to meet the essential conditions for efficiency, that the air pump shall have the least practicable amount of piston displacement acted on by the vacuum, and that the engine by which it is operated shall be of an efficiency approaching that of the main engine. The standard form of condenser is shown in Fig. 1, where the condenser proper is shown to the right, the air pump to the left, and the engine in the center. In this form the condenser is made up to 2,000 horse power. For larger powers the double type is recommended, the two single-acting air pumps being connected opposite, and the fly-wheel arranged so that it may be detached from either side in case it is desired to run the other singly. In both arrangements the air pumps are of the trunk pattern, vertical and single acting, and the current of outflowing water mixed."

We regret that the space at command will not permit a more extended technical description of this machinery, but illustrated descriptive circulars can be procured from the Company at 95 Liberty Street, New York.

RADIAL DRILLING MACHINE.

The machines, which some of our contemporaries call radial "drills," are extensively employed on this Coast, and we believe, taken all in all, are the worst designed machine tools that we have as a class; commonly with spindles less than one half the size that circumstances call for, and in nearly all cases with the reducing or back gearing on some shaft, distant from the spindle. They lack convenient supports for the work and have no sufficient means of tapping. The machine, shown on the next page, respecting which some comments were made in the last number, is a considerable advance over the common type or types of radial drilling machines, and is an indication of other innovations that may be looked for in machine-tool practice at Cincinnati, and in the West, where the



RADIAL DRILLING MACHINE.
THE LODGE & DAVIS MACHINE-TOOL CO., CINCINNATI, O.

gain of "systematic" manufacture is not commonly set up as a sufficient excuse for inefficient implements.

It costs something but not a great deal to adapt machine tools to their uses. The principal part is in providing skill to design them, and in making them specially instead of in "sets" or dozens. In respect to the latter anyone who has watched the tendency of the times can see that a "manufacture" of machine tools is becoming more impossible all the time, in so far as principal machines for planing, turning and drilling.

We will not consume space in describing the present machine, farther than was done at the beginning. The makers have complete printed specifications that will be sent free to those who will apply.

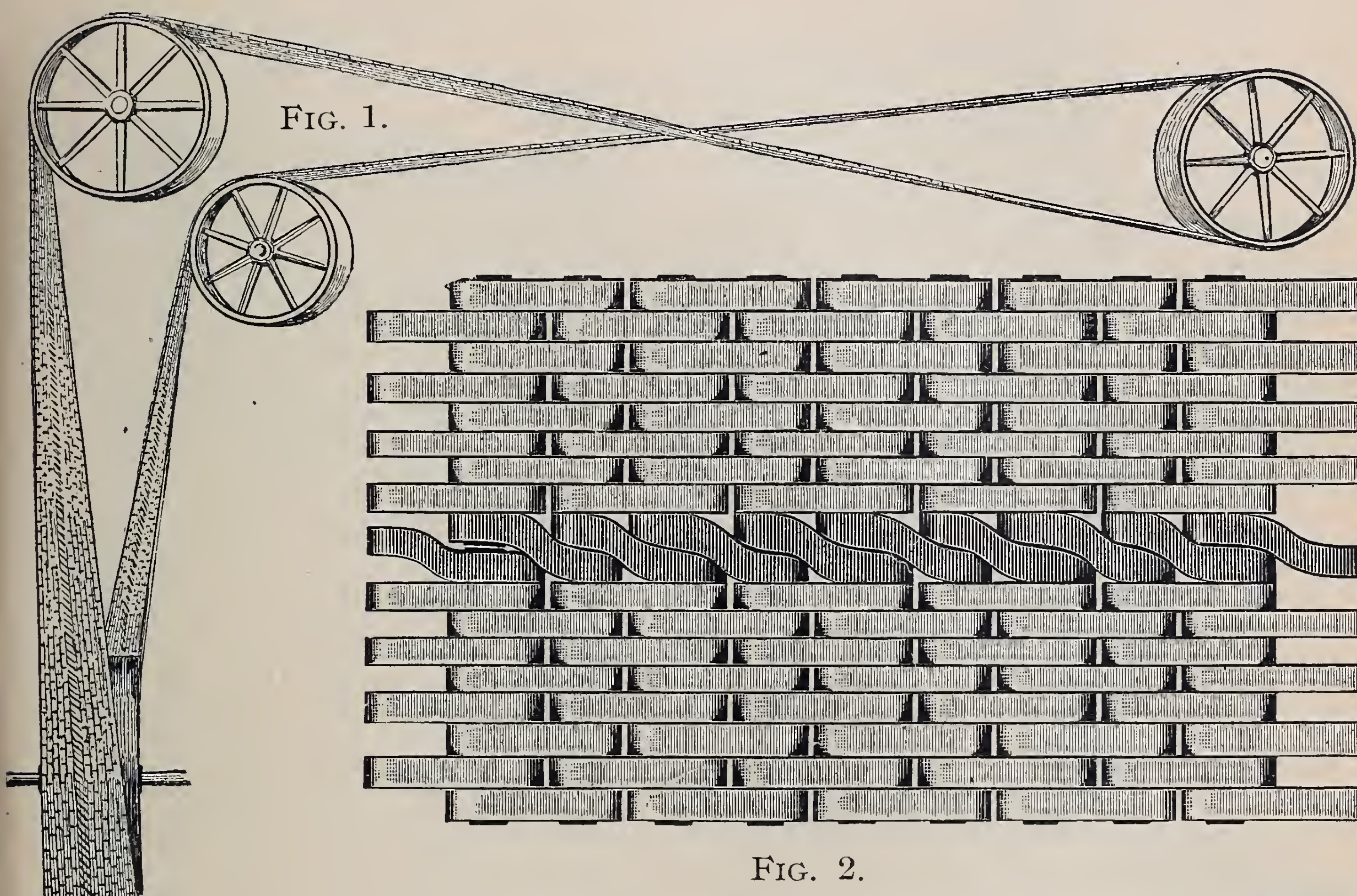


FIG. 1.

FIG. 2.

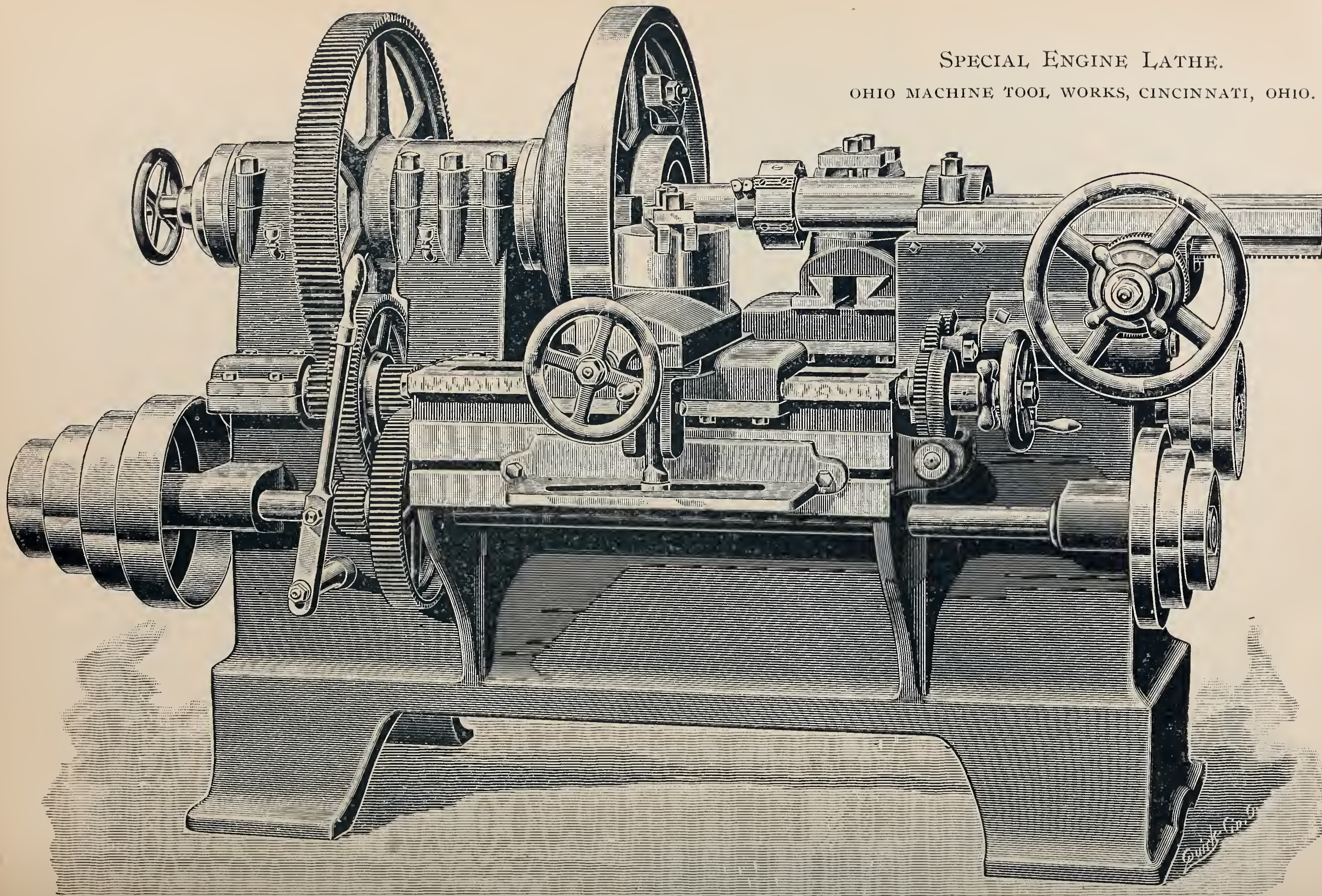
LEATHER LINK BELTS.

The H. N. Cook Belting Co., of this City, who are supplying "link leather belting" with their regular manufacture of solid leather bands, send us the drawing above and some description of these leather link belts, that will have some interest.

We must confess to a strong belief, when this form of bands were introduced some years ago, that they could not endure use up to any economic limit, because of the slipping or sliding action on the bolts or rivets, but experience has demonstrated that the wear in the bearings is almost nothing, even under heavy stress.

The diagram, Fig. 1, above shows the position in which a belt ten inches wide was operated at the American Institute Fair in New York, and indicates a capacity for "edge flexure" far exceeding what a solid band of like weight could endure.

Fig. 2 is an enlarged section of the band, showing how it is built up of links, each way from the center where the rivets terminate, so that the band will be flexible in its middle flat section, and



Special Engine Lathe.

OHIO MACHINE TOOL WORKS, CINCINNATI, OHIO.

thus fit on convex face pulleys, or bevel faced pulleys, which best suit this form of bands.

The principal object attained by this method of making leather bands is that they can be of any thickness and weight without interfering with their flexibility, which remains the same in all cases, and exceeds in any case that of solid bands. From this it follows that the bands can be operated almost without tension on the slack side or strain on the bearings of shafts, except what is due to driving traction, and this is quite a gain in many cases, and desirable in all cases, because resistance to flexure, or the power required to bend a band, is lost, and the strain of tension a serious objection.

Thin solid bands of any kind do not leave much to be desired or discovered. When taken care of they constitute an almost perfect means of transmitting power up to the limit of their tractile force, but as soon as we attempt to increase their capacity by weight and tension, difficulties begin. This the present system seems to obviate.

SPECIAL ENGINE LATHE.

OHIO MACHINE TOOL WORKS, CINCINNATI, OHIO.

The machine tool shown opposite affords a happy opportunity for comment. Engine lathes have become so nearly uniform that there is seldom anything to note in connection with new patterns, or designs, which are merely reproductions, except as to what may be called their commercial qualities, that is their excellence as to strength, accuracy and durability, which are varied to suit the price.

In the machine, shown opposite, the first thing to be noted is the abandonment of high speed for the spindle, a function that no engine lathe should have, and cannot have, without sacrifices the other way ten times as important as the high speed. There are always separate and cheaper machines for filing or polishing work, and it seems an outrage to see a good engine lathe employed for such a purpose. Abandoning high speed removes the cone pulleys from the main spindle, and constitutes the head, a plain train of reducing gearing all accessible, and with bearings, the diameter of which are arranged at pleasure, and also permits the main spindle to be made of any desirable size.

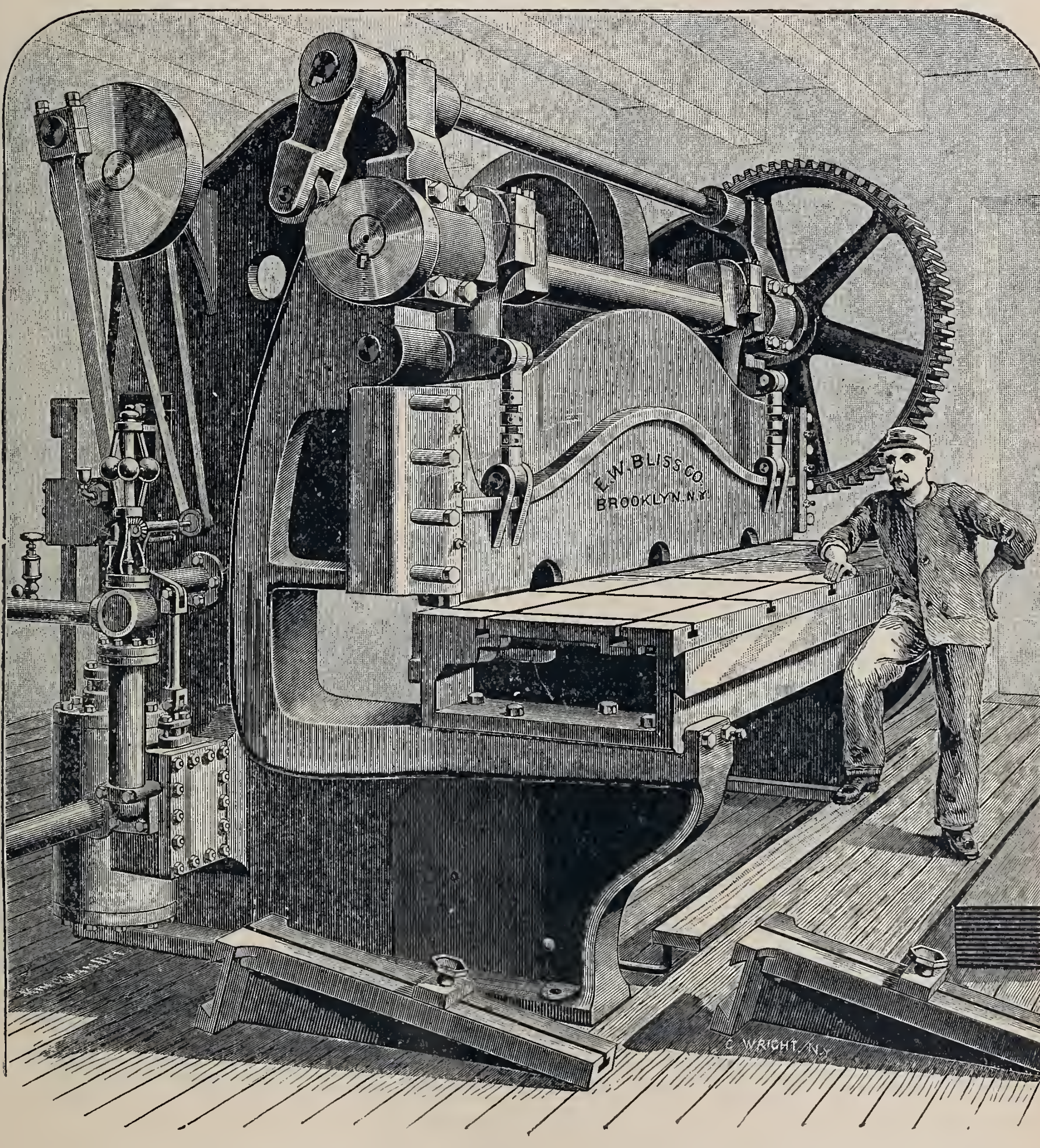
This latter is an important feature. It secures perfect rigidity of the spindle and central bore of large diameter, either of which features are much more important than high speed, and are indispensable indeed, for heavy work. The hollow cylinder permits boring bars to pass into and through the main spindle, which will at least double the boring capacity of a lathe, to say nothing of securing true work. It is an old saying that the machine works of Philadelphia have succeeded by "boring holes," which means that boring is done there by bars, supported at both ends, or at both sides of a piece, for all pervious holes, and that operation called "chucking" is almost unknown in the shops there. The present machine has the boring functions reduced to their most complete form, both for speed and accuracy.

For external cutting there are two powerful slide rests moving positively on rectangular ways, capable of resisting strain in all directions, and having compensation in all directions. This is quite in contrast with a pair of small angular ways, and incapable of resisting strain throughout an arc of more than 120 degrees.

This latter is, however, to be considered in respect to the work to be done. A lathe carriage may be mounted on any kind of ways if turning is done with sharp pointed tools feeding thirty to sixty to an inch, but are of no use when iron is to be "cut off and done with," as in the present machine. If this machine, or any other for short work, was furnished to a shop in England the chances are that the power feed would not be used at all for turning on wrought iron. The men prefer a long crank on the front, use a sponge in one hand to pour on water, and with a broad-end tool peel off the work at a feed of five to ten per inch, and "done with it" as they say.

The various adjustments, movements and capacity of the present machine are so well shown in the drawing that explanation is almost useless. The range of work includes nearly all that can be done on an engine lathe, except turning long work, and that does not belong to lathes of this class at all, but to a cheaper and more simple kind not requiring one fourth the strength.

We have, in this country, gone entirely too far in attempting to do all kinds of turning on a uniform type of engine lathes, which, by reason of adapting them to long turning, face turning and boring, are not well suited for either of these operations, and the present case has enabled some notice of the matter as well as furnishing a good example of special adaptation.



TRIMMING AND SQUARING MACHINE.

E. W. BLISS CO., BROOKLYN, NEW YORK.

The above drawing of a sheet-metal cutting machine, by the E. W. Bliss Company, furnishes an excellent example of machine design, both as to proportions and arrangement, and is one that may be studied with profit by our readers.

It is becoming, at this day, quite easy to detect in machine designs whether the strains have been ascertained, and also whether the designer had skill to distribute metal, in the proper lines and of proper section to meet the strains. This produces what may be called "mechanical symmetry," and at the same time safety and endurance.

Mr. W. B. Bement, of the Industrial Iron Works, Philadelphia, Pa., who possessed, in a high degree, the happy faculty of getting "the right thing in the right place," as he called it, once, in answer to a question, said: "follow the lines of strain with your metal, make curves of angles, and that is all you can do. Whatever *is* right *looks* right." This is true, and taste has nearly reached that point where ornament is burlesque in machine construction, and the skill of the designer stands out in his fidelity to Mr. Bement's rule.

The present machine is a good example of machine design. The makers send the following description:

"This machine is adapted for trimming and squaring sheet iron and steel, in sheets or in packs up to ⅜ of an inch in thickness and 10 feet 4 inches in length. The blades are each made of a single piece, and are carefully hardened and ground. There is an overhang or throat in the housings so that a sheet or pack of greater length than the blades may be trimmed by moving it along and taking successive cuts. The gauges are so arranged that the continued cut will be straight and in line with the first. The gap, or overhang, is sufficient to allow a plate or pack 36 inches wide being sheared lengthwise through the middle.

There is an automatic clamp directly in front of the upper blade, which descends in advance of the blade, and remains firmly pressed against the work until the cut is completed. It releases automatically as soon as the cut is made. The clamping device is operated from a cam on the end of the main shaft, which imparts motion to a rock-shaft across the top of the machine. Two levers on the rock-shaft give motion to the clamping bar, by means of two connections arranged with suitable adjusting screws to regulate the pressure upon the work.

The main shaft is of billet steel 6½ inches in diameter, with the two cranks for operating the cutter bar forged and slotted out. The shear is driven by a five-foot gear, to which a powerful clutch is attached, operated by the foot treadle. The gear revolves continuously and freely upon the shaft until the treadle is depressed, when the shaft makes one revolution, performing its work, and stops with the cranks at the upper position."

BLUFF DAVIS' BOARDERS.

A MINING YARN.

Old Bluff Davis had a coyote claim that he called a drift mine up in Eldorado County, and also kept a hotel, that is he had a double cabin, and let out one end of it in summer to people who wanted to "rough it" in the mountains. He used to come down to Sacramento several times a year for supplies, mainly of a liquid nature, and always paid in "dust" the same as was the custom in mining times of old.

Bluff knows, and is known by many of the old firms at the Capital, and wherever he calls he makes it a point to get the news, and in return relate the events at the "Ohell" mine, a name softened by his friends by combining two words into one. One of his stories is as follows:

"You may talk," said he, "of how sharp a Chinaman is, and I grant it. Sharps the word, and don't forget it; but I had two boarders last fall that laid over Chinamen three deep. They was Canadians, so they said, French Canadians; maybe they were, and if so you can just write down French Canada No. 1, and don't you forget it.

These infernal fellows were not egzacly the color of a Chinaman, or an Italian either, but a kind of bleached saddle color, with eyes and hair as black as a crow. They said they were trappers, and I allow they was, because they trapped nearly everything in the cañon for nine miles or so, up and down, and trapped me too for that matter, but I don't mind so long as they beat the Chinamen.

Somehow or other they trapped some wild hogs. Maybe you don't know that kind of animal. It is a cross between a coyote, a catamount and a greyhound — hogs as have been out a matter of five or six years, 'razor backs' we call em, because shaped like a shad on top—and run! runs not the word, they 'sail,' and the boars, we shoot them on sight to save the dogs. One will slit a dog like cuttin' open a water melon.

Well these French Canadians, or Canadian French, I don't mind which, trapped, or coralled and lassoed, I think about six of these hogs, sows mostly, tied their legs up in a bunch, tied their snoots with bale rope, and hired a wagon to haul them down to a China camp about fifteen miles below, and sold the lot to Johnny at five cents a pound. Chinaman said, 'pig heap wild, long tail, no good.'

Frenchy said, 'new breed, fine meat, much good, put him in the pen and loose him after dark.' Johnny was hungry for pork, and as I said, took the pigs, and blest if those Frenchmen didn't camp up on the hill side in the chaparral, an' near froze that night to see the fun!

The first hog loosed sprung in the air ten feet higher than the pen, and lit among the pig tails who was lookin' on. They give a yell altogether and lit out, and that hog went up the mountain side, or at least seemed to, leastway there was no where else to go, and it disappeared. Them Chinamen were beat. They never seen any hogs of that kind afore.

They built a fire and set down to gabble for an hour, and then by reaching through the pen cut another hog loose. The pen had shakes at the back for a cover, loaded down with rocks to keep them on, but the hog went through both. The shakes and rocks went all over the place. The Chinamen run and yelled, hid everywhere about, and don't you think, them French Canadians had the cheek to go down in the morning and get a dollar a piece to take the other 'devil hogs' away.

Now the mine haint panned out much this summer, and I needed the rent, but I hadn't the cheek to ask rent from anyone that could beat Chinaman that way in a pig trade."

Melbourne, Australia, has over one hundred miles of cable railway. The lines are built by the city and leased to operating companies, at a rate that provides a sinking fund, which will, in the near future pay out the whole of the borrowed capital of over $10,700,000. The fare is three pence, or six cents of our mouey. On some lines the trains are one and a half minutes apart, two carriages are run together, and are permitted to carry 54 passengers. Last year 45,000,000 passengers were carried on the city lines- The speed averages nine miles an hour. The first cable railway in Melbourne was built only eight years ago, and that city is in a fair way of disputing San Francisco's claims to being the cable railway city of the world. Mr. A. S. Hallidie, of this City, was identified with the enterprise at its beginning.

EFFICIENCY OF HYDRAULIC PASSENGER ELEVATORS.*

COMPARATIVE TEST OF THE "HYDRO-STEAM" AND PUMPING SYSTEMS.

BY PROF. HORACE B. GALE, Mem. Tech. Soc.

Modern elevators for passenger service are usually operated by means of a piston driven by hydraulic pressure, a method which fulfils very well the requirements of ease of handling, combined with smooth and rapid motion of the car. The hydraulic piston carries at the outer end of its rod one or more grooved pulleys, or sheaves, around which the wire ropes supporting the elevator are passed. By taking a sufficient number of turns of the ropes alternately around these sheaves and other fixed sheaves, the speed of the elevator car can be made any desired number of times greater than that of the piston. There are two principal methods in use for obtaining the water pressure necessary for propelling the piston, namely, the pumping, or tank system, and the hydro-steam system.

By the former, which is the older system and the one at present in more common use, the water pressure is derived either from an open tank on the roof, or from a closed tank having the upper part filled with air under the required pressure. In cities, or other places where water is expensive, the water which has done its work is received in a waste tank in the basement, from which a steam pump returns it to the pressure-tank, the same water being used repeatedly. The choice between an open or closed pressure-tank depends upon circumstances. The closed tank has the advantage that it can be operated under as high pressure as may be desired, while the pressure from an open tank is limited by the height of the building. On the other hand the open tank permits a somewhat more regular, and therefore more economical, action of the pump. As the system is generally arranged, the upper side of the hydraulic piston is always in communication with the pressure tank. When the controlling valve is adjusted so that the water under the piston can escape, the piston is driven down, and the elevator car is raised. To lower the car a passage is opened between the two ends of the hydraulic cylinder, thus equalizing the pressure on the two sides of the piston. The latter is then raised by the unbalanced weight of the car, the water flowing around from the upper to the lower end of the cylinder. As the weight of the car is usually more

*Read before the Technical Society of the Pacific Coast, Aug. 5th, 1892. Reprinted by permission.

than is necessary to give the desired speed in lowering, a part of it is counterbalanced by an iron weight, which serves also to reduce the work done by the water in lifting the elevator.

In the hydro-steam system the water acts only on the upper side of the piston. The counterbalance consists of a column of water contained in a closed cylindrical vessel called a receiver, located at such a height above the hydraulic cylinder as will give sufficient pressure to balance the desired fraction of the weight of the car. The connection between the piston and elevator car is by means of wire ropes passing around multiplying sheaves, as in other hydraulic elevators. When it is desired to raise the elevator, steam from the boiler is admitted to the top of the receiver, and, pressing on the surface of the water, forces it down into the working cylinder, driving the piston before it. To lower the car, the steam is allowed to escape from the receiver, when the weight of the car lifts the piston, and the column of water resting upon it, the water being forced back into the receiver. By closing a valve in the water passage between the cylinder and receiver, the elevator is stopped and held at any desired point. It is evident that with this system of working no pumping machinery is required.

The successful operation of the hydro-steam system depends largely upon the perfect action of the water and steam valves. The construction of these was well described in a paper read before this Society in May of last year by Mr. R. Hinchliffe, and I will therefore omit any description of them here.

The water counterbalance presents some advantages over the forms previously used. By the use of a suitable proportion between the diameter of the receiver and that of the working cylinder, the height of the column resting on the piston is made to diminish as the elevator rises, and to increase as it is lowered, thus varying the pressure of the counterbalance in such a way as to compensate perfectly for the weight of the ropes sustaining the car. Again, the ordinary counterbalance weight, by reason of its momentum, tends more or less to produce vibration of the car when it is suddenly stopped; but the water counterbalance, being cut off by the valve, can have no effect of this kind. In either of these two systems of operating elevators, the working cylinder may be either vertical or horizontal, according to convenience.

The question of the comparative efficiency of the two systems is reduced to the question, whether, under the conditions of elevator service, more work can be done upon a hydraulic piston by applying steam pressure directly to the surface of the water, or by using the same quantity of steam to pump water into a tank, from which the supply for working the elevator is drawn. It is evident that in the hydro-steam elevator the principal loss will be that due to the condensation of the steam on the surface of the water, and on the comparatively cold sides of the receiver. This loss is reduced as much as possible by clothing the receiver with non-conducting material, and by preventing the agitation of the surface of the water by the entering steam. It is to be remembered also that in this apparatus the steam is always brought in contact with the same body of water, which remains permanently at a temperature of about 212 degrees Fahrenheit.

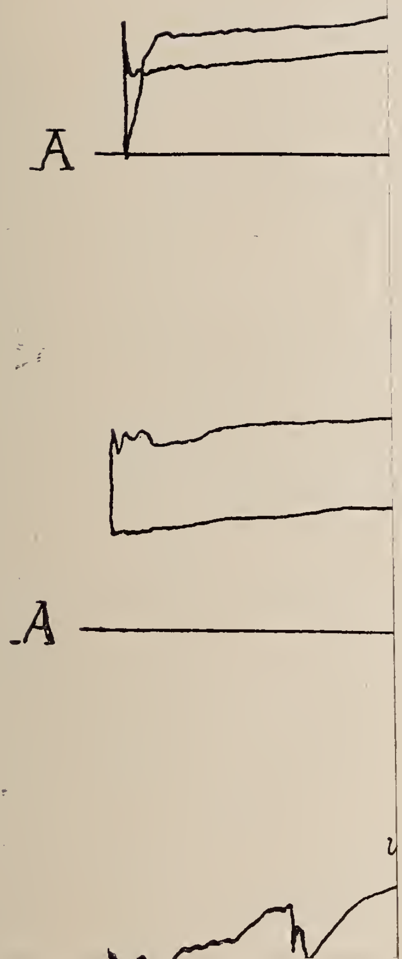
In the pumping system, especially if a compound pump is used, the losses by condensation of steam will be smaller, but we have added losses due to leakage and friction in the pump and pipes. Moreover, under this system, all the water used has to be pumped against a pressure sufficient to raise the heaviest loads which the elevator has to carry, and just as much water, and consequently as much steam, is required to raise the elevator empty as to lift it with a full load of passengers. On the other hand, in a hydro-steam elevator, by applying a throttling governor, similar to the governor of a steam engine, to the steam supply pipe, the quantity of steam used on each trip of the elevator can be adjusted to correspond to the load carried, and a considerable saving made. By this method also the speed of the elevator is kept the same under all loads within the limit of its capacity. The attendant has only to open the steam valve wide, and as soon as the desired speed is attained the governor acts, and prevents a too rapid motion.

It appeared to the writer that the only reliable way of striking a balance between these opposing elements of economy, would be by means of an accurate test of the two methods under the actual conditions of practice in passenger service. The tests here described were undertaken with that object.

The first test was made June 4, 1892, on the hydro-steam elevator in use in the St. Ann's Building in San Francisco. This elevator is of about the usual capacity of those in modern office buildings, being able to carry ten persons, and having an average speed of about 300 feet per minute. The whole travel of the elevator is about 60 feet, the motion of the hydraulic piston being multiplied three times. The cylinder is vertical, $12\frac{7}{16}$ inches in diameter; full stroke, 20 feet. The diameter of the piston rod is 2 inches, making the effective area of the working piston 118 square inches. The area of the steam receiver was, in this case, about 112 square inches, and the average height of the column of water constituting the counterbalance was 30.6 feet. The lower end of the working cylinder was in communication with the atmosphere. Steam was supplied to the receiver from a horizontal tubular boiler in the basement of the building, the exhaust steam passing through an open feed-water heater.

The test lasted from 10:45 A. M. to 4:55 P. M., during which time the elevator was run on its ordinary service, and the work done by the water on the working piston was determined by taking an indicator diagram from the hydraulic cylinder for every trip of the elevator. The feed-water pumped into the boiler during the same time was weighed in a barrel resting on platform scales. The boiler supplied steam only to the elevator, and a small feed pump. The exhaust from the feed pump was condensed in the weighing barrel, and deducted from the total water fed to the boiler, to obtain the weight of steam supplied to the elevator alone. The water level in the boiler, and the steam pressure, were the same at the beginning and end of the test.

Immediately before and after the test the boiler was allowed to stand several hours under full steam pressure with all valves closed, while the level of the water in the gage glass was noted, to make sure that there was no serious leakage of water or steam from the boiler. The scales used for weighing the water were tested immediately before the experiment by comparison with standard weights, and the spring of the Crosby Indicator used was tested two days afterward and found correct. The indicator was attached, by a ½-inch pipe, to the top of the working hydraulic cylinder, and stood about 12 inches above the piston at the top of its stroke. The cord was attached, through a reducing gear, to the piston rod. All the indicator diagrams were carefully measured with the planimeter, and from them were deduced the mean pressures on the piston, due allowance being made for the average height of the column of water between the working piston and the indicator. After the test, diagrams were taken with the elevator running empty, in order to determine the work lost in friction, and the unbalanced weight of the car and ropes. The performance of this elevator in regard to speed and smoothness of motion is equal to that of the best hydraulic elevators in use. The following are the tabulated results of the test :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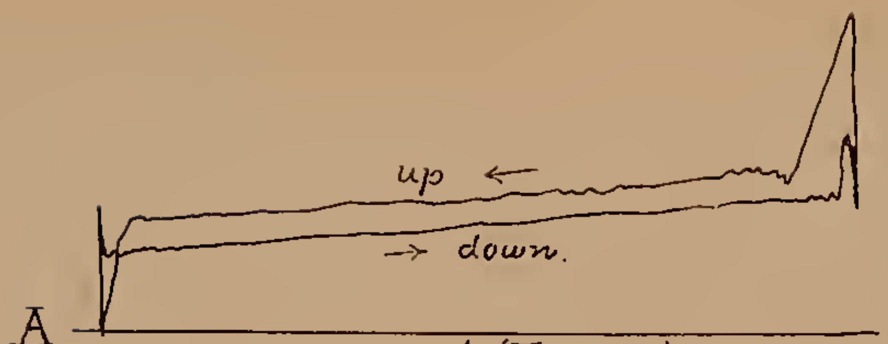
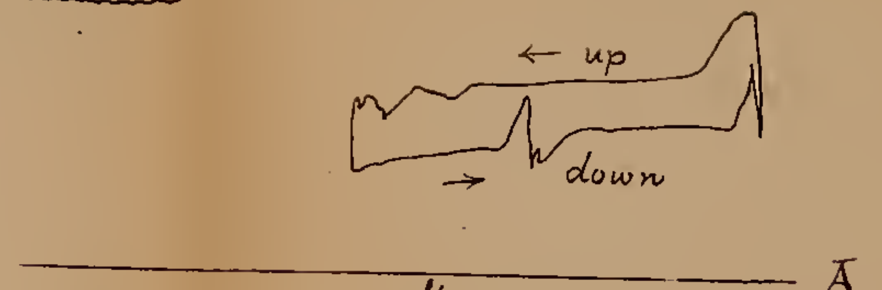
Hydro-Steam.



1. (Empty.)



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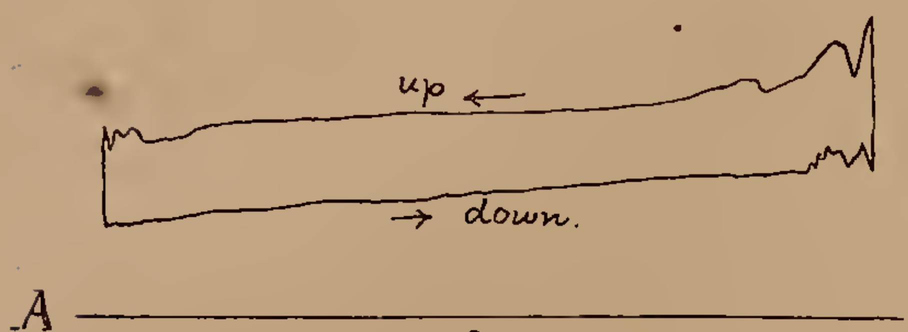

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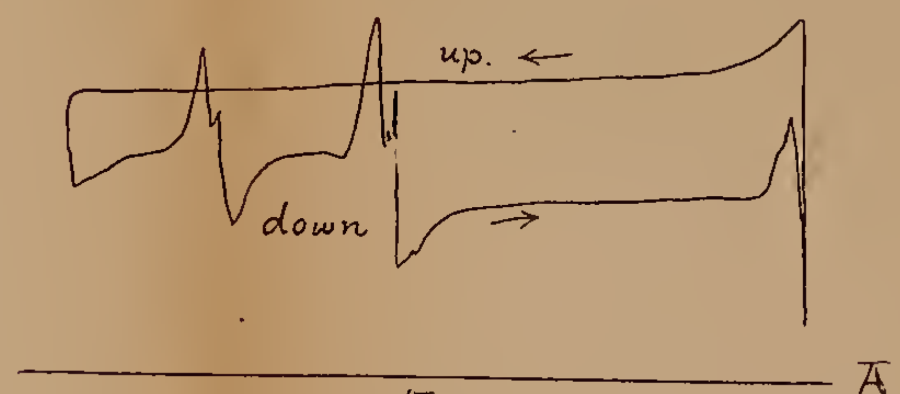

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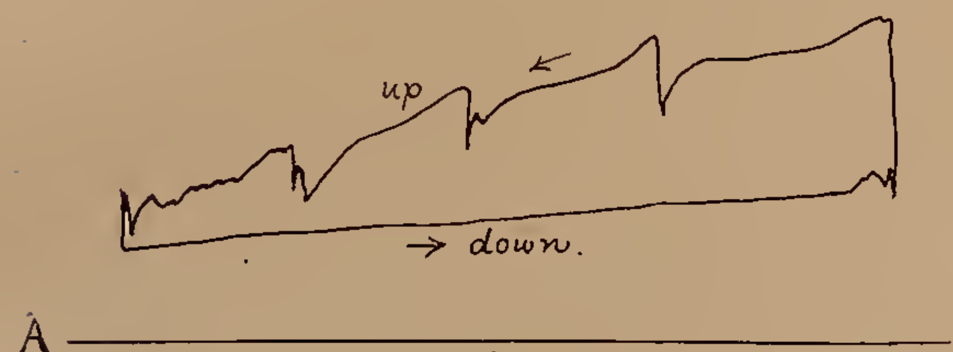

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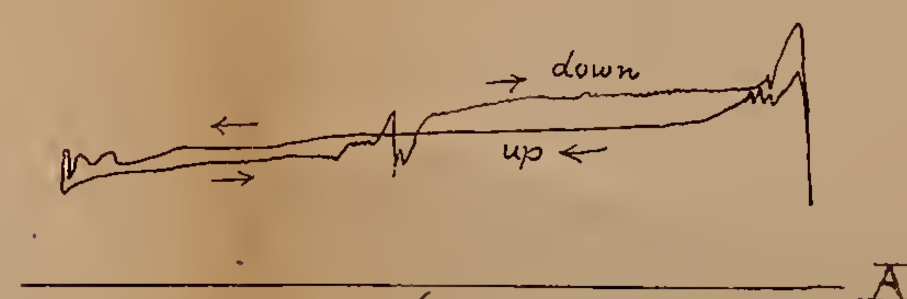
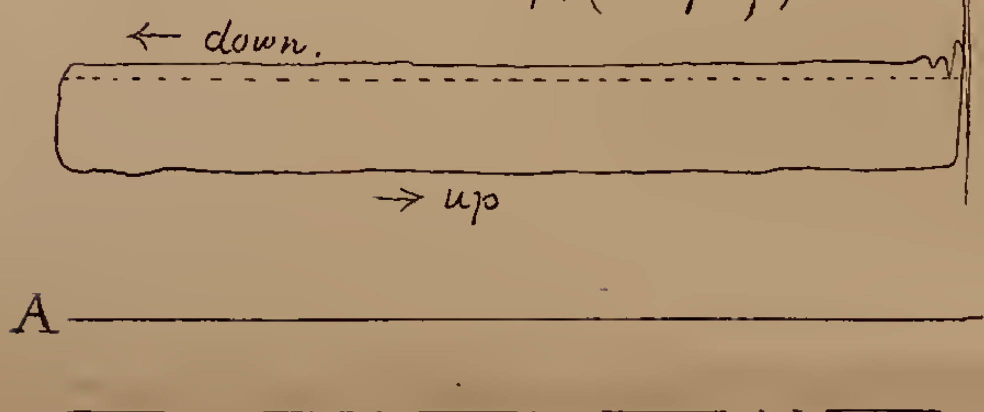


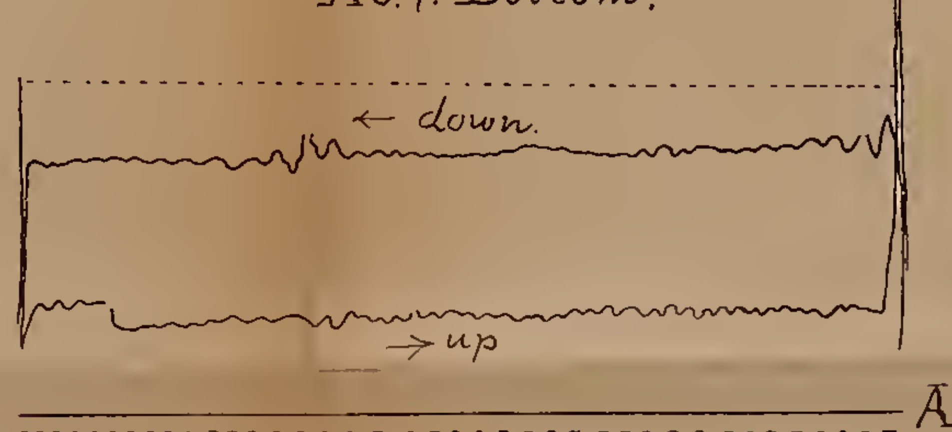
6.

Otis.

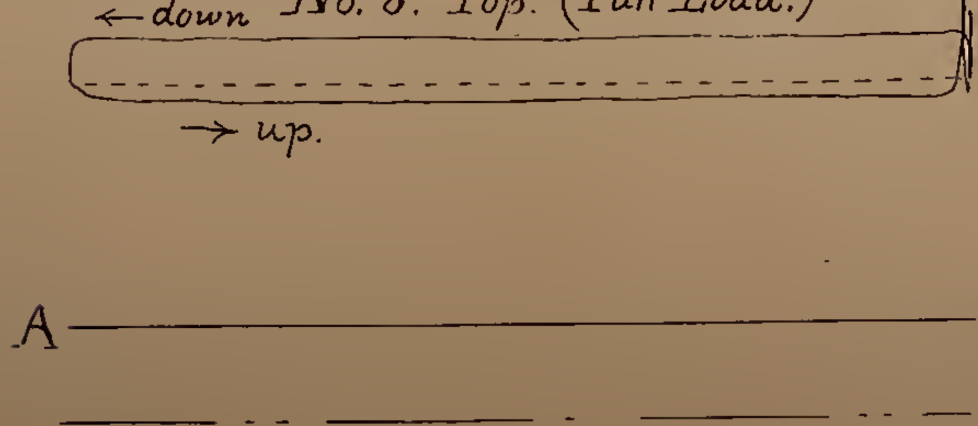
No. 7. Top. (Empty.)



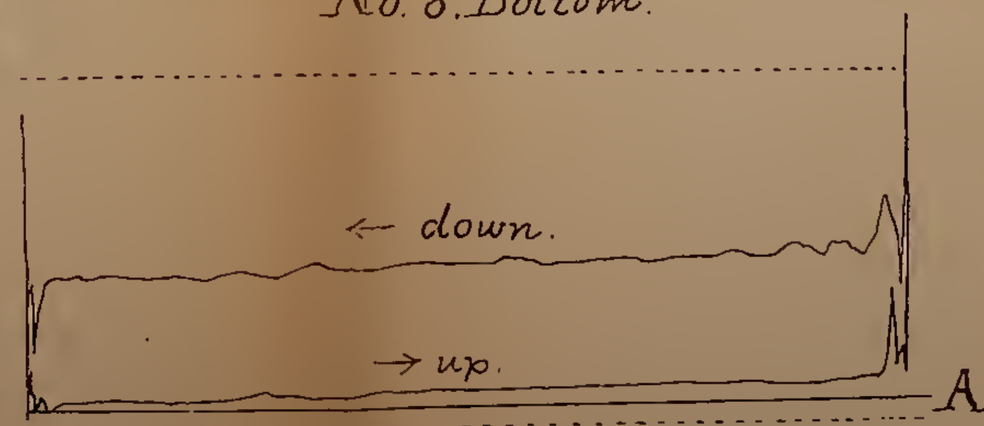
No. 7. Bottom.



No. 8. Top. (Full Load.)



No. 8. Bottom.



Duration of test	6 hours 10 minutes.
Number of trips made by elevator	256.
Total number of persons carried on up trips, includ- attendant	992.
Total travel of elevator one way	12,543 feet.
Average length of trip	49 feet.
Average speed (about)	300 feet per minute.
Average boiler pressure	81 pounds.
Ratio of travel of piston to length of indicator diagram	80 to 1.
Scale of indicator spring, pounds per inch	60.
Average pressure per square inch on working piston during up trips	48.6 pounds.
Average pressure due to water counterbalance	12.7 pounds.
Effective pressure, up trips	35.9 pounds.
Total travel of piston, one way	4,181 feet.
Number of foot-pounds of effective work done on up trips	17,711,550.
Total weight of steam supplied to elevator during test	2,057 pounds.
Work done in raising elevator per pound of steam.	8,610 foot pounds.
Mean unbalanced weight of car and ropes	842 pounds.
Mean force required to overcome friction of sheaves and piston	185 pounds.
Mean load carried on up trips	385.2 pounds.
Maximum pressure on piston per square inch	90 pounds.
Deduct for counterbalance	12.7 pounds.
Maximum effective pressure	77.3 pounds.

The observations showed very well the variable character of the work done in ordinary elevator service. The number of passengers carried on different trips during the test varied from zero to ten. Sometimes the car would go up fully loaded, and come down empty, at other times the reverse. Usually passengers would be left at various floors on the way up, and taken in, similarly, on the way down. Sometimes a trip would be made only part way to the top, the average trip being 49 feet, whereas the full travel is 60 feet. The effects of all these variations are plainly shown on the indicator diagrams, copies of some of which are appended. (See diagrams 1 to 6.) The fluctuations of pressure due to the sudden opening and closing of the valves are also apparent. It should be mentioned that as the elevator on which these tests were made was not provided with a steam governor, the full benefit of this variable work in saving steam could not be realized, most of the throttling under the small loads being done at the water-valve between the cylinder and receiver.

In order to compare the efficiency of this elevator with that of one operated by the pumping and tank system, it is necessary to know both the economical performance of a pump employed on this kind of service, and the ratio between the pressure against which the pump works, and the maximum effective pressure that may be realized in the hydraulic cylinder. The second test herein described was made July 2, 1892, with the object of ascertaining these facts.

It should be noted here that whereas on the hydro-steam system the efficiency of any number of elevators worked together is the same as that of a single elevator, the efficiency of the pumping system is greater the larger the number of elevators that are supplied by one pump. This is true, both because a large pump is more economical than a small one, and because when supplying a number of elevators the demand upon the pump is more uniform, and its action steadier.

The pump selected for this test was a Knowles compound duplex pump of the latest pattern, having high and low pressure pistons respectively 8 and 12 inches in diameter. The diameter of each of the water pistons was 7 inches, and the normal length of stroke 12 inches. The pump is located in the Redington Building, on Second Street, San Francisco, and supplies water to ten elevators,* which are used for various purposes, and operated on the open-tank system. The makers of this pump state in their catalogue that it is designed to work most economically under a steam pressure between 40 and 60 pounds. During the test the pressure actually realized in the high-pressure cylinder was kept between these limits, and was obtained by throttling from a boiler pressure of 80, thus insuring very dry steam. The pump was run at a nearly uniform speed throughout the test, the number of strokes per minute of each piston varying between 40 and 60. Before beginning it was examined and found to be in good condition, with packing not too tight for easy running, and from what has preceded it appears that it was well proportioned to its work, and run under as favorable conditions for economy as can often be found in this class of service.

The steam for the pump was furnished by a horizontal tubular boiler standing close beside it, the feed being supplied by a small single-acting pump with $1\frac{1}{4}$-inch plunger attached to the cross-head of the main pump. The displacement of the feed pump was only $\frac{8}{10}$ of one per cent. of that of the main pump, but as it worked

*Three traveling 72 feet each, four traveling 62 feet, and three with a travel of 8 or 9 feet each.

against nearly double the pressure (80 pounds, instead of 45), in calculating the work done in pumping, twice the actual displacement of the small plunger was allowed. During the trial the boiler supplied steam only to the main pump. The amount of water fed to the boiler was weighed in the same manner as in the first test, the same scales being used in both cases. The steam pressure and water level in the boiler were the same at the beginning and end of the experiment. The same test as before was also applied to ascertain that there was no leakage of water or steam from the boiler. The water gage showed the same level after standing under pressure over night.

The number of strokes made by the pump during the test was recorded by an automatic counter, and the cushion valves were adjusted at intervals so as to make the length of each stroke conform as exactly as possible to a 12-inch scale. The pressure against which the pump worked was determined by an accurate Crosby test gage connected to the forcing pipe at a point directly over the suction reservoir, the height of the gage above the mean level of the water in the reservoir being carefully measured and due allowance made therefor. The gage had been tested immediately before using it, and found correct. No allowance was made for slip in the pump, it being credited with the full apparent displacement of the two pistons.

While the pump test was in progress, observations were made upon one of the elevators supplied from the pressure tank, one of the Otis standard vertical-cylinder pattern, to ascertain the ratio between the pressure against which the pump worked, and the maximum effective pressure that could be realized on the hydraulic piston. The same Crosby indicator and reducing gear were used in this work as had been previously applied to the cylinder of the hydro-steam elevator, except that as the water acts on both sides of the piston in the Otis construction, a pair of indicators were used, and cards taken simultaneously at both the upper and lower ends of the cylinder. This elevator was used mostly for freight purposes, but the construction of the cylinder and valves is identical with that used for passenger elevators. The mean speed of the car, empty and under light loads, was about 175 feet per minute. It was found that, owing to the throttling action of the valves and passages, the effective pressure fell off rapidly as the speed of the elevator increased.

In order to get the maximum effective pressure that could be realized under full load and at low speed, the car of the elevator was loaded with bales of straw weighing 150 pounds each. With a load of seven bales the car refused to rise. With six bales it went up slowly, rising through its full travel of 72 feet in 51 seconds, or at the rate of about 85 feet per minute. This was therefore considered to be the full load for the elevator. The effective pressure on the piston, corresponding to this load and speed, was 36.2 pounds per square inch, while the pressure against the pump was 45.5 pounds, making the ratio of pump pressure to maximum effective pressure on elevator piston 1.25. As elevators of this type use the same quantity of water and steam at all loads, it was unnecessary in this case to take diagrams for every trip; but a number were taken under different conditions, and the friction and unbalanced weight of the car determined as before. (See diagrams 7 and 8.) In the diagrams taken from the top end of the cylinder the atmospheric line *A* has been raised, in the figure, above that on the diagrams from the lower end, by an amount corresponding to the difference in the level of the two indicators. The dotted lines show the static pressures at the same points. The distance between the dotted lines and the actual lines of the diagrams corresponds to the loss of pressure due to the throttling action of the valves and pipes. The results of the observations during this test are given in the following table :

Duration of test	7 hours.
Average boiler pressure	80 pounds.
Diameter of pump pistons	7 inches.
Diameter of pump rods	$1\frac{3}{4}$ inches.
Diameter of feed pump plunger	$1\frac{1}{4}$ inches.
Effective area of pump pistons, corrected for rods and feed-pump plunger	37.9 square inches.
Mean length of stroke, each pump	12 inches.
Number of double strokes, one pump, by counter	9,987.
Total travel of both pump pistons	39,948 feet.
Mean pressure on force pipe, by gage	41.2 pounds.
Mean height of gage above water level in supply tank	9 feet $11\frac{1}{4}$ inches.
Total effective pressure against pump	45.5 pounds.
Total work done in pumping	68,888,329 foot-pounds
Weight of water fed to boiler	2,965 pounds.
Foot pounds of work in pumping, per pound of steam	23,234.
Diameter of hydraulic cylinder of elevator	$13\frac{15}{32}$ inches.
Full stroke of hydraulic piston	24 feet.
Diameter of hydraulic piston rods (two in number) each	$1\frac{1}{4}$ inches.
Ratio of multiplying sheaves	3 to 1.

Scale of indicator springs, pounds per inch........	30.
Height of water column between upper and lower indicators....................................	25 feet 9 inches.
Unbalanced weight of car and ropes.............	640 pounds.
Mean force required to overcome friction of sheaves and piston....................................	154 pounds.
Maximum load carried, according to indicator diagrams....................................	895 pounds.
Maximum effective pressure per square inch on hydraulic piston...............................	36.2 pounds.
Ratio of pump pressure to effective pressure on working piston...............................	1.25

The above tabulated results afford us the means of comparing the efficiencies of the two systems of operating elevators. From the first table, we find that the whole quantity of steam supplied to the hydro-steam elevator during its test was 2,057 pounds, and that the total travel of the working piston in lifting the car during the same time was 4,181 feet. The effective area of the piston being 118 square inches, the volume of water that would be required to do this work under a pumping system would be $4{,}181 \times 118 \div 144$, or 3,426 cubic feet. The maximum effective pressure realized on the piston of the hydro-steam elevator was 77.3 pounds, and calling the ratio of pump pressure to effective pressure on the piston 1.25, the pump would have to force this volume of water against a pressure of 77.3×1.25, or 96.6 pounds per square inch. The quantity of work represented by these figures is 47,658,383 foot-pounds, which, divided by 2,057, gives us the number of foot-pounds per pound of steam as 23,169. This is what a pump must do to equal the performance of the hydro-steam elevator under the conditions of this experiment. The actual performance of the pump tested, in foot-pounds per pound of steam, was, as shown by the table, 23,234. The difference being less than $\frac{3}{10}$ of 1 per cent., the writer concludes that the efficiency of the hydro-steam elevator as at present in use for passenger service is about equal to that which can be obtained with tank elevators operated by a good compound pump. Compared with the performance of the non-compound pumps often used for elevator work, the hydro-steam system would therefore have a considerable advantage; and a further advantage may be gained, doubtless, by the use of the throttling governor in the steam pipe.

The average number of pounds of steam per trip used by the hydro-steam elevator in this test was about eight, which agrees well with the results obtained in the experiments of Mr. Hinchliffe. The travel of this elevator being 60 feet, and its capacity 10 persons, we are afforded a rough means of estimating the boiler power required for passenger elevators on this system.

It is interesting to notice that the quantity of steam actually used per trip by the elevator in these experiments was about three times what would have been required to fill the receiver if there had been no condensation. A rough calculation also shows that the heat required to raise the temperature of the iron sides of the receiver from 212 degrees to the temperature of the entering steam is sufficient to account for the greater part of this condensation. It is therefore probable that a comparatively small proportion of the steam is condensed on the surface of the water, the depth affected being very small.

It is evident that if means were devised to prevent the lowering of the pressure, and consequent cooling of the inside of the receiver during the exhaust, the heat required to raise the temperature again to that of the admission steam might be largely saved. To accomplish this, the writer has suggested that the top of the receiver, instead of being opened to the atmosphere when the elevator is lowered, be put in communication with the bottom of the working cylinder, thus equalizing the pressure above and below the piston. To raise the car, the steam would then be exhausted from beneath the working piston, and at the same time admitted to the top of the receiver. This plan would require only one additional valve, and it is thought would prevent a large part of the condensation due to the alternate heating and cooling of the receiver. On some elevators now under construction this principle is to be adopted, and the writer hopes soon to be able to present results with these, showing a considerable advance in economy.

A further matter of interest brought out by this test is the fact that if the work done by the elevator on the piston on the down trips be subtracted from the work done by the piston on the up trips the mean effective pressure is reduced to 10.122 pounds per square inch, and the net effective work, up and down, is only 2,420 foot-pounds per pound of steam, instead of 8,610 foot-pounds. This indicates that the modern passenger elevator is, to say the least, an exceedingly uneconomical form of heat engine. The inference is that if the steam could be worked in such a way that the down traffic could assist in lifting the up traffic, a very large saving would be effected. It is a pleasure to state that Mr. Hall is now well on the way to the solution of this problem, and if he is successful, we may expect soon to see a three-fold increase in the efficiency of the hydro-steam elevator.

LITERATURE.

Our review space for the present month is too crowded to permit more than compendious notice of a part of the matter at hand.

The Engineering Magazine.

AUGUST, 1892.

This number contains articles on compressed air apparatus for driving street cars, showing that this much opposed system may yet find a place among modern methods. It has done so in one case in France, and under the great advances made in pneumatic transmission in the last few years, must be considered anew.

An article on the Mississippi River, controverts, and seemingly with much success, the claim that a certain amount of debris must be carried along and lodged on the sides of all rivers flowing through sedimentary plains. The contention must be judged from facts, and these involve periods so long as to permit wide divergence of opinions. Facts point to the possibility of scouring river beds; opposed to the theory of building up along their course.

There is an article on high-priced labor that attempts by facts to prove that high-priced labor is often the cheapest, but the author does not seem to have discovered that the price of labor is a direct result of efficiency—necessarily so for all staple commodities produced, and that efficient labor is not a result of high wages, but the high wages is a result of efficient labor. It is the "cart before the horse," so to speak. In another place the author makes the mistake of saying that they do not employ wheelbarrows in dam building in India, because the machinery is too complex. The object of using baskets is to have the work "tamped in" by those who carry the baskets.

Journal of the Franklin Institute.

AUGUST, 1892.

This is No. 800 of this Journal, which if divided by 12, shows a life of 66 years, and this is for our, or any country, an old age for a serial publication.

In the present issue is a remarkable paper by Dr. Hermann Mehner, on a "Motor Without Fuel, or the Second Principle of Thermo-Dynamics," showing a wonderful acquaintance with the researches in this field, and made as popular as the nature of the subject will admit. The paper is somewhat shorn of its value by being written in the "first person," a common fault in this country, and a method not permitted at all in some cases in Europe.

The other papers, of which there are three, have the usual measure of merit; one on the Nicaragua Canal, by the General Manager, Mr. Geo. W. Davis, adds a good deal to previous information on the subject, but is too long for further notice here.

The North American Review.

AUGUST, 1892.

Major Powell, in this number, writes of "Our Recent Floods," and says the destruction by recent floods in this country, equals that of some memorable wars. His article is florid in style, as all his writings are, but contains many facts presented in a very graphic form. For example, the entire rainfall on the earth he assumes to be 152,000 cubic miles, or fifty times as much as Lake Superior contains. Rain is distributed in zones of latitude, beginning at 100 on the equator and diminishing gradually to 5 or 80 degrees each way.

His remarks on rain makers "bombarding the heavens with pop-gun balloons," are caustic and justifiable. They occur in an estimate of the weak powers of man in controlling natural elements and phenomena, and leads up to what can be done in controlling flood waters.

The three great tributaries of the Mississippi River are the Missouri, Ohio, and Upper Mississippi. The former furnishes the least volume of water, but nine tenths of the detritus matter in the great stream. The control, or any attempted control, must be by storing the water, straightening the streams, or embanking them.

Major Powell, as director of the U. S. Geological Survey, naturally says the first thing to be done is to make surveys, topographic, geological, and hydrographic, but these should be made with reference to some definite future work, and at this time they transcend any power that our country seems to possess. The field is too immense to consider.

Colonel Robert G. Ingersoll's article on Thomas Paine, is the most remarkable one in the present number, and will do something to dissipate a shameful ignorance that now exists respecting this great man.

Mr. M. D. Conway, who of all living writers is most able, has prepared a life of Thomas Paine, and judging of what is here said of the work, few Americans can read it without a blush of shame when the treatment of Paine is made a matter of history. "It was the cause of America, that made me an author," said he. He was the soul, and a great part of the intelligence that directed the young life of this country. He made war on slavery—on all slavery, one might say — both of fact and opinions. This took him to France, where European liberty was born, and where he came into conflict with the church. Col. Ingersoll says: "He stood for liberty against kings; for humanity against creeds. He gave his life to free and civilize his fellow men."

Mr. F. B. Thurber, writing of "Business in Presidential Years," says of the silver question:

"Power drills, stamp mills, and improved separating processes have largely increased the world's output of silver, at a time when public sentiment in some countries is working against silver as a currency and in favor of a less bulky and more convenient medium of exchange.

The production of gold has not increased so rapidly, and, in consequence, silver has depreciated, while gold has appreciated in value.

We have sought in this country, to keep the two metals on a parity, by having the government buy up the surplus of silver; but this cannot go on forever.

The History of the Band Saw.

BY SAMUEL WORSSAM.

This is by far the most extensive account of band-sawing machines that has been prepared, and will have especial interest at this time, when band sawing, especially for large timber, is a subject of wide interest on this Coast. Our crowded space this month will not permit quotations from the treatise, nor even a list of the subjects, but we will say that anyone concerned in band sawing, or in making machines for that purpose, will derive much interest, as well as useful information, from Mr. Worssam's book. It contains, besides history, down from the Newberry machine of 1808 to the present time, complete explanation of appliances for the care of saws, including brazing or joining, swaging, setting, and sharpening implements. The book can be ordered from the author, at Idol Lane, East-Cheap, London, England. Price 18 pence. By mail, 40 cents.

Stone.

JULY, 1892.

It will be a matter of astonishment to some of our readers if we claim that this serial, published in Indianapolis, Ind., and printed there, is the finest magazine that has come to hand this month. We speak of paper, print, make-up and general dress. The matter is mainly devoted to stone, masonry building, etc., with sections of technical matter. It is a creditable and even a marvelous production of the kind.

A History of Higher Education in Ohio.

This work is a bulletin of the "Bureau of Education," Department of the Interior, at Washington, containing an account of thirty-three universities and colleges in Ohio, with more than forty plates of buildings, grounds and interior views. The origin and rise of these institutes, which form the theme of the work, is very interesting, and the facts go to prove the enormous development of educational matters in Ohio, which is principal among the states in this respect. One thing is perplexing—preparation of a report of this kind by the general government. It would seem to be a proper work of the State itself to prepare, or at least to publish such a report. It was prepared by Prof. Geo. W. Knight, of the Ohio University, and Prof. John R. Commons, of Oberlin College, Ohio.

RECEIVED.—*Vauclain Compound Locomotives. Trade Circulars, Betts Machine Co. Dredging on the Pacific Coast. Bulletin No. 97, of the California State University. Consular Reports No. 140, May, 1892.*

"INDUSTRY."

JOHN RICHARDS, Editor.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

San Francisco.

Founded 1888. OCTOBER, 1892. No. 51

Local Notes.

To several inquiries respecting "Techno,"—he is among the Dutch, "Stuck in Holland," for want of space, but will emerge in due time with some interesting notes on that queer country, and then, after a time in England, return home wiser, if not better. His "notes" are to end in January next, we are sorry to announce.

Mr. Otto von Geldern, Civil Engineer, of this City, has been engaged, since the 1st of September, in making an investigation of Petaluma creek, with a view to an improvement of that stream to facilitate its navigation. The traffic is considerable, and the question quite an important one to the population of a fertile and prosperous district. A scheme for the improvement of the creek will be made after the hydrographic surveys are completed. The examination is made for the Government, under the direction of the U. S. Corps of Engineers. These small estuaries or creeks extend up into most of the large valleys in California, and afford a very cheap means of transportation by steamers and sailing craft. Those emptying into the bay or ocean are kept open for some distance by tidal scour, but can be much extended at a moderate expense. Such water ways will some time determine the location of manufacturing industries, as has been the case in Stockton.

Bulletin 97 of agricultural section University, of California, states that Prof. E. W. Hilgard has been granted leave of absence for one year, and that E. J. Wickson will act as director in his place during this term. The Bulletin relates to prunes, apricots and peaches, especially to analysis of their elements and qualities chemically. The variations of different elements between fruit grown at Niles, San Jose, and Tulare are surprising. The "ash" varies from 37 to 61 per cent., acid from .23 to .95, and sugar from 8 to 17.

The California Association of Civil Engineers of this City, have issued a circular letter, the purpose of which is to secure the selection of a properly qualified engineer as superintendent of the public streets in San Francisco. We are unable to publish this circular for want of space, but the proposition seems very much like recommending that a surveyor be appointed to determine land boundaries. Who, if not an engineer, can perform the functions of superintendent of public streets? The making, repairing and maintenance and care of streets is certainly engineering work, and that anyone not so qualified should be entrusted with public work involving the expenditure of more than a million and a half dollars each year, is anomalous, and accountable only in the fact of its being made a "political" office. It is a lamentable circumstance that the exigencies of municipal politics demand that construction and maintenance of streets be in the hands of non-professional and unskilled people. The method of making streets, considered in respect to their use, the climate and kind of material available, and other conditions, is an exceedingly intricate problem that should be determined by a board of public works, not alone by an engineer officer, but when it comes to an official without even technical knowledge, it is time for remonstrance.

The appointment of a special advisory board of engineers to consult on the important matter of the sewerage of San Francisco was a move in the right direction. The board consists of Col. Geo. H. Mendell, U. S. Engineer Corps; Professor Geo. Davidson, of the U. S. Coast Survey, and Irving M. Scott, Esq., of the Union Iron Works. This board has selected and recommended the appointment of Marsden Manson, late Chief Engineer of the Harbor Commission, and C. E. Grunsky, C. E., of this City, to prepare plans for a comprehensive system of sewerage works. This selection cannot fail to meet with complete approbation. Both the chief and his assistant are too well known to our readers to require commendation, and their selection is but a reflex of the able and impartial judgment of the advisory board. Mr. Manson's administration of the harbor works, during six years past, proves his inflexible and honest devotion to his profession, while his ability in the special field to which he is called is exceptional and remarkable, because coupled with a knowledge of science exceptional, even among engineers. Of Mr. Grunsky, his standing aside from his profession, in which he is eminent, is such as warrant an honest and faithful discharge of any public duty with which he is entrusted. It is not the custom of INDUSTRY to indulge in laudation, or even merited praise, but this case is one that permits an excusable exception.

The rope-way at Pomeroy, Washington, for conveying wheat in sacks, made by the Vulcan Iron Works here, and mentioned in our last issue, is in successful operation. It is a "gravity" line with a fall of 1,920 feet, conveying 80 tons in 10 hours. The sacks weigh 130 pounds each, and are conveyed by a steel rope ¾ inch diameter, supported at distances from one to three hundred feet apart. Two men do the loading at the top, but the discharge is automatic, the sacks being dumped into a chute. The Vulcan Company publish a pamphlet containing illustrations and all kinds of information respecting the construction and operation of these telpher lines and their application to various purposes.

Geo. W. Melville, Chief of the Bureau of Steam Engineering, U. S. Navy, is chairman of Section G of the Engineering Congress to assemble at Chicago next year. This section is devoted to naval architecture and marine engineering, and Chief Engineer Melville has requested Mr. Geo. W. Dickie, of the Union Iron Works, San Francisco, to present a paper before the Congress on certain topics, not fully determined at this time. The selection is a good one. Mr. Dickie was also chosen as one of the officers of this section but could not attend. His paper will, no doubt, be a principal one. His qualifications as an engineer, and also as a shipbuilder, together with perhaps the widest experience of anyone in this country, should lead to a paper of great merit. He has designed, or mainly designed, all the deep-water steamers that have been built on this Coast.

The *Peru*, of the Pacific Mail Line to China, recently built at the Union Iron Works in a remarkably short time, has a record for first performance that has not been excelled in any country. The machinery was started at the dock and ran for a few hours, not more than five. The vessel next went out to sea on her trial trip, and without mishap of any kind, ran twenty-two hours, including in that her test for speed over the measured course. She was then loaded and ran to Yokohama, a distance of 4,750 miles, without her engines being stopped. If there is any record to excel this it will be a favor to have it sent in. The chief significance of the fact is in showing that work of the highest class was done on the vessel. The result should be a matter of concern and of pleasure to every citizen of this City and of the Pacific Coast.

The Temescal tin mines have been closed, and at the same time is closed the confidence in such investments, both in respect to home and foreign capital. If it were possible to ascertain the effect this unfortunate matter will have on the industries of this Coast it would astound people. The fact of failure is bad enough, but the effort to deceive people, is the worst feature of the case. One has only to turn back nine months or so, in various serial publications in this country, to find statements that the Temescal mines would produce all the tin consumed in this country, while in the face of this, as we pointed out in a late issue, there is not a reputable mining engineer in this City that did not believe from the beginning that there was no chance for pay ore at Cajalco Hill.

Mr. J. L. Heald, of the Heald Agricultural Works, Contra Costa County, fifteen years ago commenced to fit snap rings in the pistons of his engines, with a play of $\frac{1}{16}$ inch sidewise. His proposition was that a snap ring, unless loose, was a poor packing, or no packing, and that the oil gum on four surfaces would make up the play, and if it did not, the movement of so light a piece so short a distance would do no harm. This is an important matter in practice, because out of hundreds of engines for hard duty, fitted in this manner, not a single cylinder has failed to wear smooth and keep tight. In Mr. Heald's business there was frequent occasion to overhaul old engines or those that had been in use, and it was the exception to find snap rings that were loose in the piston heads, but it was not unusual to find cylinders cut out by rings fitted tight, and thrust out by the pressure beneath them so as to score the cylinders.

COMMENTS.

Thomas Fitch, of Arizona, the erratic author of a book called the "Millionaire of Tomorrow," has managed, as all writers do, to hit upon some truths worth remembering. He says, in speaking of what we are pleased to call "booms" in this country, that it is not wealth owning, but wealth producing that creates great cities, or to put it in another form, instruments are of no avail unless used. Even the erection of buildings or other works is of no consequence unless they are employed. The active element is the fact, and Mr. Fitch has not lacked examples to suggest the axiom above noted.

The change in this country from the broad flat form for boats, yachts and general sailing craft, to the deep cutter type, is the end of an illusion that goes to show how far and how long people can be mistaken in a matter capable of practical demonstration. Ten years ago this form of boats was called the American type, and the races with foreign built vessels was understood to be a controversy between the two systems. Now, all this is changed. Even Mr. Burgess, the celebrated designer of fast yachts, declared for the cutter type, and henceforth the question will not be in respect to deep and shallow hulls, but to the form of deep hulls, sail rig, and the like. There is no question respecting the speed at which a broad flat boat can be driven over smooth water, but such boats are neither seaworthy nor safe, even in protected waters.

The Hon. W. C. Squire, U. S. Senator from Washington, and former Territorial Governor there, sends us a copy of his speech on defences for the Pacific Coast, which is cogent, clear and forcible from the common standpoint of view, and supposing robbery and murder under the name of war, have to be provided against, his portrayal of the great inland sea of Puget Sound is graphic and true, and in this part of the Coast we can only find the fault of a proposed gun factory being established on the Sound instead of at San Francisco. The speech was made in committee of the whole, and pending consideration of an appropriation for a gun works on this Coast. We have not space to follow Mr Squire's argument, but will only say it is one of the best in all respects, length, style and nature, that we are likely to have on this subject.

Some reports from England respecting new ships for the Atlantic service are astounding. The two new Cunard ships the *Campania* and *Lucania* are to be 600 feet long, 70 feet beam, and of 30,000 horse power. Harlan and Wolff are to build a new steamer for the White Star Line 34 feet longer than the *Teutonic*, or 600 feet, beam 69.8 feet. The *City of Paris* and *City of New York*, recently transferred to Aemrican register, are 527 feet long, or 73 feet shorter than the immense vessels above mentioned. The British companies have a wonderful start in ship building. Other countries have what is called a "stern chase." By the time the French, Germans or ourselves construct ships to match the English they have new and greater examples ready.

We wonder if people will quit "making" things, to build and manufacture them. Just at hand, in good authorities, we find heavy machine tools for special work, "manufactured" by a well-known firm. In juxtaposition, steam engines "built" by another firm. Now both these things were "made" by all rules of grammar and good sense. To build is to raise up by an accretion of parts, to add to by degrees, as in the case of a house, bridge or a "building." A "builder" is one who constructs houses — not machines, these are made. "Manufacture" means a constant or uniform production as applied to articles made in large numbers and duplicated. The meaning and uses of the proper terms are clear, why not use them correctly when they are equally as short and euphonious as the wrong ones?

The ethics of the labor problem continues to be the burthen of page after page, writer after writer, mostly from those who have no practical experience in dealing with either labor or capital. As to the causes of labor disaffection and practical methods of its removal we have nothing. No one who is concerned in the difficulties of labor disaffection can gain any light or comfort from the whole mass of matter, and yet there is lying just before their eyes, as it were, the only remedy that can ever produce harmony and peace. The laborer must be made responsible for labor, that is, the work as an element of production, in our skilled industries, must be treated as that part, and the only part a workman has to deal with. The labor cost of a ton of iron, a locomotive, a house, or a web of cloth, in this and other countries, should be ascertained, and then if we cannot attain the same result, the workmen become responsible.

The railway bill that passed the House of Representatives last session, relating to brakes and couplings, will, no doubt, meet with amendments and opposition in the Senate, which is largely made up of railway men and their affiliated friends. The Act provides that all driving wheels must be fitted with brakes before 1895. All new cars after that date to have continuous brakes, and all cars then in use to be so fitted before 1898, also that all new cars must after 1895 be fitted with automatic couplings, and old cars must be so provided after 1898. This legislating for five years, or even for two years hence, smacks a little of politics. The clamor of the public became too serious to be disregarded. About 2,500 persons are killed and over 20,000 injured each year by railways in this country.

It is announced that the Americanized Inman Line will make Southampton their terminal port in England. This may be so, but we doubt it. They might nearly as well go to London. Had they chosen the Bristol Channel, as the Anchor Line thought of doing some years ago, one could see some object in it, but Southampton away around Lands End, on the Continental side of England, seems a queer place when time is a main element in the service. The removal of the Peninsular and Oriental Company's business away from that port to London, about fifteen years ago, has no doubt taught the people there the value of trans-ocean traffic, and has led to concessions of an enticing nature. Bristol channel has some annoying regulations and charges, also lacks water unless much dredging is done, but it is almost as direct as Liverpool from New York, and less than half as far from London. The Continental Mail steamers, German and French, touch at Southampton, but it will be found hard to direct present travel from Liverpool.

It is undoubtedly a foolish policy of the Canadian Government to disregard treaty stipulations, and impose discriminating tolls on American commerce passing through the Welland Canal, and the reprisal method of discriminating against Canadian vessels passing through the St. Mary Canal, is a case of cause and sequence. The next movement will be for the Canadians to construct a canal of their own to gain an entrance to Lake Superior. When this is all done, what is gained? The whole matter comes from a viscious policy of international strife, based on the mercantile theory that one country gains what another country loses. A little intelligent statesmanship, divested of the jingo spirit, would have led to good will and increased trade between the countries. The whole thing is hateful and inexpedient, the outcome of what the Canadians call "patriotism." The canals, with the commerce of both countries passing through them, could be better maintained and be made ample for all purposes.

The overland railways pay the Pacific Mail Steamship Company $850,000 a year, or $70,833 a month, "to not carry freight." In other words they tax those who ship goods, that much over and above the railway charges, and pay the money over to the ship company. The case may be stated another way. The trans-continental lines maintain a steamship line, and tax the shippers for that luxury. The money is received in one pocket, and shifted to the other. The Pacific Mail line has also a Government subsidy, and a part of this public money is paid again to an English line to prevent them from stopping at Panama with American freight to Valparaiso, and other ports on the west coast. This latter was made public by the United States Consul at Panama, about two years ago. It is a fine system, typical of our day, and then we wonder at strikes, and complain of young men who decline to follow the old method of making a living. Such an example is enough to demoralize the business of any country.

The Government of New South Wales, in Australia, appointed about two years ago, a commission to inquire into the causes of strikes and their remedy. The committee consisted of seventeen men. Fifty meetings were held. The report is in a volume of one thousand quarto pages, containing, as a review of the work says, the social and economic knowledge of the world on this subject. In so far as we can gather from this review, no new light of value, or expedient promising success, has been presented, and indeed no true theory of the difficulty, which is, that labor is not set off as an independent element and made responsible. We have almost alone argued this thing for three years past, and the time will come when everything else fails that the true light will come. The first thing is, in all considerations of the kind, to distinguish between the rate of wages and the amount of wages. No commission in New South Wales or anywhere else will get far in dealing with the problem until this distinction is made.

The *Iron Age*, of August 25th, gave a full account of the Fort Payne enterprise in Alabama, where about two millions of money belonging to credulous stockholders has been lost in a coal, iron, and general scheme. The manager of the whole matter, as well as exponent of its economical phases, was a Mr. Rice, whose qualifications consisted in his being a "money maker." That was enough for a certain class of investors, who are too apt to regard money getting as a matter of chance, and not essentially one of creating values by industrial processes and work. The town of Fort Payne and its environment of iron and coal were "boomed." The fact that no more iron furnaces were needed in this country at the present time was not considered, neither were technical and economical circumstances looked into. The manager was a "money maker," and that was enough. The whole scheme has collapsed, and the losses will amount to at least two millions of dollars divided among seventeen thousand stockholders. Such things are enongh to kill confidence in "money makers," and that far may do some good. A report by some competent and honest engineer would, no doubt, have condemned the project at the beginning.

The *Chronicle*, newspaper here, states that 180,000 workmen in Philadelphia own their own homes "because of the wages paid in protected industries." The fact is remarkable, but the "because" part is nonsense. Workmen own houses in Philadelphia because it costs less than one half as much to do so there, than in other American cities. There is a system of perpetual ground rents, and no one thinks of paying out the "fee" in land. When prices are quoted there for ground it means six per cent. on the fee ; for example, if one buys a lot at $6.00 per foot, that means the "fee" is $100 a foot. This can be paid up in pure silver in sums of $200 or more when the purchaser chooses, or he can pay the interest forever. His deed and transfer are complete, but the ground rent follows. The old Quaker families own most of the land, and the municipal taxes are assessed on the real estate. Heresy and Henry George ! Here is his system applied, and the "because," in the case at first quoted, finds its base in this fact. They do not, in Philadelphia as here, "fine" a man for improving the land, building a factory, or owning implements of production. Not only this, every family, by law, is compelled to have 15 feet square "open to the heavens." This prevents tenement houses, and promotes private building, but a newspaper is not supposed to know these things.

There appeared, in several of the foreign journals, last month, criticisms and comments upon the industrial war now going on in this country. The matter is not agreeable reading for thoughtful people, but is more likely to be impartial when friendly, than views expressed here where every one has some interest or prejudice in the case. *Engineering*, London, speaks in a disparaging manner of labor unions in this country, claiming they are arbitrary, quarrelsome, and more under control of leaders than in the old world, also less responsible because of having no accumulated funds, and depending on "assessments" when money is required. In other places there are comments upon the distribution of wealth, and the rise in this country of more than four thousand millionaires in forty years past, also on the relation between employer and employed, brought about by the centralization of our industries, and legislation that tends to still more antagonize conflicting interests in the future.

Industrial Notes.

Work is now definitely commenced on a ship canal to connect Lake Michigan with the Mississippi River. This lake, as may be seen on a map, reaches down into the land, so to speak, nearly a third of the way across the country, and the natural circumstances determine Chicago as the starting point for such a water way, also accounts for its phenomenal growth as a commercial center. The canal will be 160 feet wide and 35 feet deep, and will rank with the great works of the kind at Suez, Manchester and Amsterdam. One purpose of the canal, and, indeed, the immediate cause of its commencement, is to furnish drainage for the City of Chicago. It will, no doubt, be extended to serve that purpose in a diligent manner.

The Manchester Ship Canal, from that city to the Mersey estuary, a distance of 35 miles, it was thought for a long time would be completed within, or near the estimate of 45 millions of dollars, but making due allowance for the death of Mr. Walker, the contractor, and the muddle that arose by the company assuming the construction work, also for one serious accident by the giving way of retaining works, the whole scheme now presents the usual phase of costing double. A good many works in England, of a less nature, but harder to compute, have been built within the estimates, and in this case the circumstances will be much against the enterprise. Human sagacity can hardly foresee the adverse "quantities" that will thrust themselves in when such vast works are undertaken, but it is about time there was discovered some kind of a "constant" to be introduced in estimates, that would either cover, or leave a margin.

At the late meeting of the British Association, Mr. Head read a paper on anti-friction bearings, or rather on bearings to operate without lubrication, and stated that he had made such bearings of finely pulverized "carbon" and steatite (soapstone). The processes of preparation were not described. Professor Unwin had experimented with these bearings and found the co-efficient of friction, independent of the area in contact, and to increase only when temperature became excessive. The name given to the substance is "carboid." One of the bearings, tried under heavy pressure, was heated up to a purple color without injury. Now is a good time for such experiments. There are many signs of a new material for bearings, but not a corresponding promise of any substance that will not be affected by oils, so the course of experiment is mainly confined to dry bearings. Oil is a powerful re-agent, and metals or glass alone seem to withstand its effects.

We often see the name "Tangye" applied to steam engine frames. The Buckeye Engine Co., for example, call one type of their framing the "Tangye" one. The name originated about 1870, when the celebrated firm of Tangye Brothers, of Birmingham, England, went into the manufacture of steam engines. The firm consisted of James, Richard, Joseph and George Tangye, an old Cornwall family of Quaker lineage, and when the business had grown to a large one, Joseph and James Tangye went down into Cornwall to retire, as we would say, leaving the management with Richard and George. The type of engine to make was a problem. Just at that time there were changes going on, and American practice for stationary engines was in advance. Various parts, such as valves, crank, piston, etc., were chosen, but the frame was a "settler." James, who was down at Redruth, was written to, and he straightway proceeded to "whittle out," in a little shop he had there, a model for an engine frame. It was both business and amusement for him. The model was sent up to the works at Birmingham and adopted.

It is noted in a contemporary that many of the machine works in Cincinnati, Ohio, do not have foundries of their own for making castings, but buy them from others that devote their whole attention to that branch of work. The same system prevails in New England, where machines assume the nature of a "manufacture," and the castings are uniform, or measurably so. The New Haven Tool Company formerly procured their castings from a foundry near them, at a rate lower than the company could possibly make them, for the reason that the foundry kept the local work to "fill in," and was thereby enabled to keep a constant force of skilled men to meet emergencies and to command extensive contracts in New York.

The transmission of power by air, in Paris, has become a very important enterprise. The old plant has been increased 4,000 horse power, and a new station of 24,000 horse power being prepared. The compressors are compound, and of enormous size. The economy of working has been much increased, so the losses between that and other methods is more than balanced by the conveniences and advantages of the air system. Professor Riedler, of Berlin, the author of "Indicator Research in Pumping," has contributed a good deal in improving the methods. Much credit is due the French engineers for taking up and developing this system of transmission, which has wide reaching social and sanitary influence, as well as commercial, and it is not difficult to understand their success. The French are the "systematizers" of the world. There is an old adage that the German people philosophize, the French classify, and the Anglo-Saxon apply. The main thing, in such cases, is to perceive what is wanted, and then adapt it to circumstances.

It is 47 years since Sir William Armstrong erected the hydraulic cranes, and other apparatus at the New-Castle Quay, in England, and it is noteworthy that the methods employed, in so far as the main elements, have never been much departed from. For example, the fine elevators in the Palace Hotel, in this City, were constructed from designs by Mr. Geo. W. Dickie, then connected with the Risdon Iron Works, who were the contractors. These elevators were, in the main, modeled after the practice of Sir William Armstrong, and have operated without intermission, or loss, for sixteen years past, and with an economy and complete action that is hard to excel. Perhaps no invention of equal importance and intricacy was ever more nearly perfected in the first instance. We mean in its detail, because the method was not new in 1846, but its application was limited and important down to Armstrong's time.

Common opinion respecting the energy or pôwer of flowing streams is nearly always exaggerated, and greatly so. A current of large area conveys an idea of an almost irresistible force, when in fact it represents but a trifling power. The following table, taken from the *Mechanical World*, will serve to show how little work is

Velocity of Stream.		Equivalent Head.		Pressure.	Total Energy.
Miles per Hour.	Feet per Second.	Feet.	Inches.	Pounds per Square Inch.	H. P. per Square Ft. Sec. Area.
1	1.467	0.033	0.43	2.1	0.0055
2	2.933	0.134	1.62	8.4	0.0445
3	4.4	0.300	3.60	18.9	0.15
4	5.867	0.534	6.42	33.6	0.355
5	7.333	0.834	10.07	52.5	0.694
6	8.8	1.200	14.39	75 6	1.2

represented by the current of streams. The force that may be utilized, or the head seen in the third and fourth columns, is very slight, and is the height to which the water will rise when obstructed. This depends, in a measure, on the shape of the obstructing faces. A plain radial current wheel will give not more than two thirds the work that a well made Poncelet wheel will, because the water will rise higher on the curved floats of the latter named wheel. Current wheels are usually a disappointment, because falling short of their expected duty, and a habit they have of going off in floods.

The differential cable drums, made by the Walker Manufacturing Company, at Cleveland, Ohio, which were described in an early number of this Journal, is one of those common-sense inventions that propagates itself if time is allowed. The company own some advertising space in this Journal, and the publishers complain that each month the "sold list" must be changed. Monthly was bad enough, but now the notices come twice for each issue. Considering other expedients adopted to compensate for wear in the grooves of driving drums, we think it is about time that the differential ones were applied on the City lines here. Mr. John Walker, the founder and manager of the Walker Manufacturing Company, an engineer of high ability, has for many years past made a special study of tooth gearing and heavy transmitting machinery. The result has been the development of this great enterprise at Cleveland. Engineering companies and firms all over the country send to Cleveland for large wheels and pulleys, and in a recent case, a spur gear wheel of 66 tons weight was furnished to accompany a mining plant made in England, for a South African mine.

Mr. Lewis E. Hicks, writing in *Science*, gives the following table in respect to storing water, which, with some addition, is of much practical value. The addition we suggest is a change in the first column, substituting from 100 to 1,000, continuing the table to 1,000 or even 10,000. This can be done from the formula below:

Table showing the annual average depth of water for ratios varying from 50.1 to 100.1, and for rainfall varying from one to two feet, the annual evaporation being five feet; seepage, two feet, and the run-off 7.5 per cent.

Ratio of Catchment to Reservoir Surface.	Depth of Water for a Rainfall of				
	12 Inch.	15 Inch.	18 Inch.	21 Inch.	24 Inch.
50:1	None.	None.	None.	None.	5. ft.
60:1	"	"	"	.87 ft.	2. "
70:1	"	"	.87 ft.	2.19 "	3.5 "
80:1	"	.5 ft.	2. "	3.5 "	5. "
90:1	"	1.44 "	3.12 "	4.81 "	6.5 "
100:1	.5 ft.	2.37 "	4.25 "	6.13 "	8. "

The formula for computation is $D = \frac{R r r'}{100} - (e + s)$, in which R = rainfall, $\frac{r}{100}$ = runs off, r' = ratio of basin to reservoir, e = evaporation, s = seepage, and D = annual average depth of water resulting from the given conditions

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To those who have small, flat roofs to provide on house-decks, partitions, or elsewhere, we offer the suggestion of their looking at the roof of the first steamboat they travel on. These are commonly made of canvas, or duck, saturated with paint, and subject in many cases to incessant travel over them. Such roofs cost not more than half as much as tin or other sheet metal ones, are easy to make, and easy to repair in case of accident. If exposed to sparks, a coating of sand sprinkled over the last coat of paint, when wet, will form a good surface to resist fire. It is a wonder such roofs are not oftener employed on buildings, especially as the example is so common in the case of boats.

It is a singular thing that if an induced current of water, or a reduced pressure of water, for fire purposes, can be taken from high pressure mains, that it is not done, and the system applied in London, Hull, Liverpool, Sydney and other places where the high pressure service exists. It is, at least, eight years since Mr. Greathead, the inventor, or adaptor, of the tunneling shield that bears his name, invented a very complete induction apparatus for connecting the high pressure of 700 pounds per inch to 100 pounds or so, for fire purposes, and presented his methods in a public paper. This use for fire purposes would seem one of the principal functions of a high pressure service, but there is no doubt a good deal of loss by the induction or ejector methods. It is true the margin of utility would, in many cases, rest on the difference of pressure thus produced, compared with that of the common service mains, but this latter is hardly ever enough for efficient fire service.

Electricity.

The Second Avenue Street Railway, in New York, has applied to the State Board of Railway Commissioners for permission to operate its line by means of electrical storage batteries. The Kings County Elevated Railway Company, in Brooklyn, N. Y., have also decided to adopt the storage system. The weight of batteries having now been reduced nearly one half, and it is likely we will see a wider application of the storage method than heretofore on lines now operated by horses, and in other cases where there is a dread of depending, for all the cars, on a central generating plant; also in cases where overhead conducting wires are objectionable. The fact is that there has been a good deal of contention against storage batteries that had its origin in commercial, rather than scientific or economic reasons.

In some recent experiments with electric cooking apparatus, it was found that a "day current" could be applied at a cent an hour for a frying pan six inches diameter, heated to 260 degrees. Unless there is some mistake in this, or even if the cost was twice as much as stated, we are well on the road to electric cooking. One can not heat a six-inch pan in San Francisco for ten cents an hour with coal, unless the vessel is one of a number operated together, besides there is no comparison in cleanliness and convenience between the electric and fuel heating. If, however, one can turn a switch and cook a steak, boil eggs and make coffee, it means a good many social changes to meet this circumstance. Bachelors will become more numerous for one thing.

In electrical literature, perhaps no better illustration has ever appeared of the mathematical grasp of the subject than the papers now being presented in *Industries*, London, by Mr. James Swinburne, on the "drop" in current transformers. He refers to Sir William Thompson's still more mathematical treatment of the the subject, but we doubt if it will better illustrate the manipulation of conditions, relations and results in concrete formulæ. It is humiliating to compare some other older branches of industrial art with the electrical interest, combustion for one, and see the difference between scientific and empirical methods; nor must it be forgotten that nearly all that is learned or known of electrical phenomena has been at first derived experimentally. An intangible element without a known source or relations, reaching into the unfathomable mysteries of nature, treated mathematically, while common processes of turning and planing iron rank with Aristotle's therapeutics.

At the last prize contest instituted by the City of Paris, for the best electric meter, the prize of 5,000 francs was awarded to Prof. Elihu Thompson, of the Thomson-Houston company. With the desire that this sum should serve for the development of the theoretical knowledge of electricity, he has requested the general manager for Europe of the Thomson-Houston International Electric Co., to offer a prize for the best work on a theoretical question in electricity, and to organize a committee who should propose the subjects, examine the productions and decide the prize. Such committee has been chosen, and have decided that the prize should be given for an investigation on one of the following subjects: "The heat developed by successive charges and discharges of condensers under different conditions of frequency, nature of dielectric and quantity of discharge." The award to Prof. Thomson is quite an honor, coming as it does from a source without favor or partiality. His disposal of the prize is graceful and appropriate.

Mr. Eugene Griffin, in February last, lectured before the Franklin Institute, Philadelphia, on the well worn subject of "Electric Power Transmission," and gave the following account of the great plant at Tivoli, in Italy, from whence the current is sent to Rome, eighteen miles away:

"The motive-power it derived from a water flow of about 132 cubit feet per minute under a head of 157 feet.

Six turbines of 300 horse-power each, are coupled direct to alternating dynamos, 230,000 watts capacity, at 170 revolutions a minute.

In addition there are three direct-current machines, each coupled to a turbine making 375 revolutions, which are used as exciters for the alternators.

At full load, a potential of 5100 volts is used. The current is conducted by means of four bare copper wires (between Nos. 7 and 8, B and S gauge), carried on iron poles with oil insulators.

The drop in potential amounts to twenty per cent. on a line of 18.4 miles (circuit 36.8 miles). At the outskirt of Rome near Porta Pia, is located the distributing tower in which the current is transformed from the pressure of 5000 to one of 2000 volts. This is again reduced at centrally located points to 100 volts, at which it is furnished customers.

When fully completed the central station of Rome with its 5,000 horse power capacity will be the second largest lighting plant of Europe, Berlin having the largest."

MINING.

THE SOURCES OF GOLD.

The following, published some time ago in the *Milwaukee Journal*, answers in some degree a question often asked, respecting the origin of gold:

"Primary rocks, of which granite is the most common type, are not metaliferous. Some ores, especialy iron, are often found among them but are not of them. Indeed there is reason to suspect an origin of all metals after the granite surface had cooled to a degree to permit the formation of aqueous rock deposits. Volcanic eruptions, which are supposed to proceed from a depth of about forty miles, rarely have metals of any kind in their lavas, and it seems reasonable to suppose that if they existed there they would be thrown out to some extent at least. All metal deposits are found in what may be called the crust of the earth, and the material of this is not of igneous origin. How they came there and from whence is a problem that scientists are trying to solve

Aerolites may be held to be minute planets that in the course of ages have yielded to the earth's attractive force and fallen. These are mostly iron in a fused state and very tough quality, holding from 1 to 20 per cent. of nickle and cobalt, a combination unlike anything of terrestrial kind. In recent years it has been asserted that earthly material composed a part of them, and more recently that carbon or diamonds, and now gold, are claimed to be of their substance. Manifestly these claims will be subjected to the most critical tests before science will indorse them. It is a new field of inquiry, and if these things are established as truths, they will mean much, for it may prove that all our metals can be traced to a celestial origin.

Gold is always found pure, and has no known ore. A common matrix is quartz, but such rock by no means indicates the presence of this metal. Its existence here is, geologically considered, of very late date. It is found only in what may be called surface deposits. And in localities wide apart. In this respect it is similar to our diamond mines which are deposits without order or arrangement. If gathered by aggregation of atoms through electrical agencies, like most metals, it must have a source somewhere from whence it is drawn. And yet such sources are unknown. And if of star dust what brought the molecules together in a few places and left the world barren elsewhere? Such questions excite curiosity and perhaps time will answer them."

NOTES.

Some experiments recently made at the "Texas and Georgia" mines in Shasta County, California, with the MacArthur-Forrest cyanide process for gold extraction, have turned out very favorably. Ores assaying $213, yielded 68.8 per cent. in 48 hours, without perceptible loss of the cyanide. The tests were made by Mr. R. G. Hart, who also treated some ore from the Bully Choop mine, which assayed $51.48 per ton, and yielded in 60 hours, $49.78, with a loss of 4.5 pounds of cyanide per ton. The result is such that the latter named mine is to be fitted up for the MacArthur-Forrest process. These are among the best results reported and indicate ores especially adapted for the cyanide extraction process.

The shutting down of the Broken Hill Mines in Australia may have some effect on the price of silver. Six thousand men are idle or were at the last advices. The dispute is respecting piece work, or ton work, which is proposed. The men want the present rate or near it, and the management know the men can near double the output if they adopt more economical methods. At this distance no one can judge of the points in dispute, but this will not deter the "press" from settling all points completely. The Broken Hill Mines, in the edge of South Australlia, are the largest silver producing ones in the world, at this time, and the present causes can not long delay the resumption of work there.

The superintendent of the Johannisburg mines in the Transvaal, has been inventing an improvement in stamp battery gearing by employing two cams for each stem or head one at each side, so the stamp is lifted first from one side and then from the other, turning accordingly. It is claimed that better working is secured and there is no end thrust on the cam shaft. There may be some slight advantage in such an arrangement, but it seems neither extensive nor obvious enough to make up for the lack of uniformity in the parts, difficulties of casting, extra cost and slower speed of the cam shaft.

TECHNOLOGICAL COLLEGES.

Dr. J. D. Cogswell, of San Francisco, five or six years ago attempted to found and endow a technological college at Twenty-sixth and Howard streets, in this City, and straightway set out, as people generally do in such cases, to hunt up some distinguished people who knew nothing of the matter in hand, to help him. There was not, as now remembered, a single person concerned who had even had the least experience in "technology," or anything that bore any analogy to the various arts and industries that are covered by that flexible term, unless we include the "machinery" of municipal politics.

It was much as though a company of our merchants should conclude they would build a steamship, take her out to sea and navigate her. As a matter of course, people accepting such a trust or business had an object, and as that object could not well be confined to a furtherence of the Doctor's plans, they set out to follow their own plans, and the end is chaos — the school building turned into a fort some time ago, with two sets of claimants; and so far as can now be seen, no probable good to come of a large investment that might have been a great honor to Dr. Cogswell, and of much advantage to the City.

There was no lack of information to guide the founder of the school, not only in the way of past history of such institutions elsewhere, but the peculiar circumstances here, under which alone such a school can succeed, were pointed out and explained to him. But the Cogswell College is not the theme in view, further than it illustrates a method of failure, and affords thereby some guidance for the future.

An "omnibus" school of the kind, to teach "technology," may properly be a part of the machinery for secular education, and has its possible place in the educational institutions of a country, but the public here, and in most places, have a very different idea of such schools. In this City, for example, where there was one person who took a correct view of the Cogswell School, there were ten who thought it was to confer skilled training, a calling of direct money value, a short and gentlemanly way into those rough arts we call industrial manufactures. The same ideas are entertained in respect to the great schools at Berkeley, and at Palo Alto, and are in a great degree mistaken.

We do not desire in any way to disparage these or other institutions of the kind that are now, as we may say, the very core and essence of educational progress, but to point out that the popular conception of them is wrong, and that the modern "manual training school," in so far as accomplishing its supposed objects, is a myth. Such schools prepare young men to "enter" a works and begin their experience there, but the manual training part is, as we believe, not only of little or no use, but sometimes a positive hindrance to a young man who wants to turn his skilled efforts into earnings.

The time spent in a mechanical laboratory, if devoted to mathematics, chemistry and physics, would be much more usefully employed, because the laboratory or workshop not only consumes time, but distracts attention from other things. It becomes in the student's mind the objective point, so to speak, a kind of ideal to which all else is directed. The student imagines that here is carried on those mysterious arts that exist in the workshops of the country, which he can there acquire and go out into the world and use. It is perhaps unnecessary to explain that such a conception is wrong.

Suppose that a young man who has graduated at one of these manual training schools is to apply for a situation in an engineering or machine works, or in a works of any kind, conducting operations such as are imitated in a laboratory. He will be asked respecting his scholarship, his knowledge of delineating work and other things taught at his school, but nothing as to his practical experience in manipulative processes. Not only this, it will in most cases be considered a disadvantage if he has been tinkering in a college laboratory with any other view than that of understanding the "nature" of processes, because he will not only have to learn over anew whatever he has been doing, but has to "unlearn" it as well.

For confirmation of this, one has only to go out among people engaged in our skilled industries and ask those who have come through the training schools. If this is not conclusive, ask the superintendents and foremen their opinion of the manipulative training a boy or student acquires in schools. This will not only be evidence, but "fact," and must ever remain a test of the system.

Our contention is that it is inherently impossible to teach shop manipulation in any useful degree in a school, and what is taught should be confined to explanation and illustration of methods. It is an ideal scheme set up in these modern times, of blending education with practical industry, possible, perhaps, in the case of agriculture, where the graduate himself applies what is learned, and the laboratory is a real farm, but impossible if he is to become one among many others who have learned a manipulative art in a different manner.

Teachers cannot be procured for such training schools, because the thing to be taught is mainly empirically derived and learned. There is no sensible foreman who will claim that he could instruct a young man in the only correct way of performing the hundreds, or even thousands of operations that are necessary in a factory or works. He might teach "one" way of doing things, but of nothing could he say, this is the only "correct" way. The next man will have another method. There are no fixed rules, consequently no way of teaching by rule.

There is one useful function of a workshop connected with a technological college or school, as before remarked, it assists students in understanding the "nature of processes," but even this is unnecessary in most cases. Our workshops are open for the purpose, and a visit of observation there is worth ten times as much as an equal time spent in a laboratory.

The Cogswell College is a mistake in so far as attempting to teach practically mechanical trades. It is only a waste of the Doctor's money, that might be applied to a more useful purpose. If the college was in the country where access to workshops was not possible, the case would be different. Here we think the manual part is unnecessary, and a loss of time that can be more profitably devoted to other studies.

THE WAGES-FUND THEORY.

The New York *Nation*, in a late issue, presents a ponderous article on the "Wages' Fund Theory," as they call it, the principal objection to the opposite theory being, as we suppose, that Henry George was the first man to make this economic principle clear. The *Nation* contends that wages are paid out of accumulated capital, and cites the Panama Canal as an example where there was no product to pay wages. The *Nation* is, in this matter, in the unusual position, for that journal, of begging the question.

No one has contended that wages are not advanced, in many cases, from accumulated capital, which is the same thing as saying the investor in industrial enterprises must, in some cases, pay in advance for what he buys. In the case of the Panama Canal the *Nation* says "we need only ask whether the laborers employed received their wages in certain undivided shares;" and says this illustrates the fallacy of the "industrial partnership theory."

To this the answer is, that the laborers did not work for shares. There was no such bargain. The shareholders bought a canal, or what they thought would be a canal, in which labor, as well as certain ornamental expenses and concessions, surveys and so on, was a part and had to pay in advance for all. The only question, in any way affecting a wages' fund theory, is whether the men performed the labor, and returned *quid pro quo* for the money paid them.

In the Homestead case, also cited, it is pointed out that the vested interest theory will not hold, because the works might have exploded, and no capital been earned, in which case the wages would have been paid out of accumulated capital. This again is begging the question. We are not aware that Mr. Carnagie brought any capital to this Country, and if Homestead had exploded he has a reserve of profit on other labor to rebuild the place. The illustration does not apply. As to vested interests we do not know what meaning the *Nation* attached to this term, but if it means "invested property," and the proprietors of the *Nation* had their plant in Homestead instead of New York, they would feel there was an interest of some kind in the case.

IMPORTED GOODS IN 1891.

The following table shows the value of imported goods brought into the United States in 1890 and 1891 from European countries. It is made up from the late Government reports, and shows an increase of imports equal to 20 per cent. in 1891.

	1890.	1891.	Increase.	Decrease.
United Kingdom	$186,488,000	$194,723,000	$8,235,000	
Germany	98,837,000	97,316,000		$1,521,000
France	77,672,000	76,688,000		984,000
Italy	20,330,000	21,678,000	1,348,000	
Netherlands.....	17,029,000	12,422,000		4,607,000
Switzerland	14,441,000	14,118,000		323,000
Belgium	9,336,000	10,945,000	1,609,000	
Austria-Hungary	9,331,000	11,595,000	2,264,000	
Spain	5,288,000	6,033,000	745,000	
Sweden and Norway	3,534,000	3,723,000	189,000	
Russia in Europe	3,306,000	4,729,000	1,423,000	
Turkey in Europe	1,426,000	1,854,000	428,000	
All other European	2,962,000	3,475,000	513,000	
Total...........	$449,980,000	$459,299,000	$9,319,000	

Imports from South American countries have also increased to the amount of $28,661,000, as follows:

	1890.	1891.	Increase in 1891.
Brazil	$59,318,000	$83,230,000	$23,912,000
Venezuela	10,966,000	12,008,000	1,042,000
Argentine	5,401,000	5,976,000	575,000
Columbia	3,575,000	4,765,000	1,190,000
Guyamas..............	4,918,000	5,653,000	735,000
Chili...	3,183,000	3,448,000	265,000
Paraguay	1,754,000	2,356,000	601,000
All other.............	886,000	1,226,000	340,000
Total..........	$90,001,000	$118,662,000	$28,661,000

From other American sources the imports increased as follows:

	1890.	1891.	Increase in 1891.
British North America..........	$39,396,000	$39,434,000	$ 38,000
Mexico......................	22,690,000	27,295,000	4,605,000
Central American States........	8,052,000	9,799,000	1,747,000
British Honduras	186,000	219,000	33,000
Mequillon and St. Pierre Islands.	37,000	15,000	

The total imports were $478,500,000, so it seem if there was a falling off in some things there was an increase in other things to correspond.

TRADE NAMES.

Trade names are a disagreeable feature of modern industry. They become all the time more irrelevant and silly, but are happily confined to English-speaking countries, or mainly so. One of the last is a "Magnolia Piston Packing" evolved in England it seems, and an excellent device, barring the name. What magnolias have to do with engine packing is not clear. It is not more or less silly, however, than dozens more of such names, for which relevant terms can easily be found in our own or some other language. A multiplicity of things in one class, demands distinguishing names, which should be, when possible, other than personal names, and, as before said, there are plenty of them.

We have seen, in the last twenty years, a great reform in technical literature. It has become as grammatical and elegant as the class called "pure literature," a result due, in a large measure, to schools and colleges devoted to technical studies. Trade literature does not improve in the same way, most of it is written in the first person with "I," "we," "us" and "our," in violation of good taste and to its own detriment. Whatever is addressed to more than one person, that is to the public, should evidently be written in the third person, and the personal pronoun reserved for personal communication, that is, to one person. A sign or trade notice that contains enough words to violate syntax or etymology does so without fail. "Smoking Not Allowed," for example, "permitted" is meant, "allow" is a different act. On one of our ferries one may read "Gent's Department." What is a "gent?" "Men," which is meant, contains one letter less.

BYRON SPRINGS.

Among the varied physical phenomena of California there is perhaps nothing more strange than the springs at Byron, Contra Costa County, within sixty miles of San Francisco.

There is no lack of hot springs throughout the coast range, a vestige, no doubt, of decaying volcanic action, or perhaps of chemical reactions, but nowhere else, so far aswe know, such a wonderful diversity as at Byron. Water at 60 degrees boiling up out of the ground within fifty feet of other water having similar minerals, at a temperature of 130 degrees, each bearing from 500 to 600 grains of chloride of sodium to the gallon. One hundred feet away is sulphur, white and black, as it is called, hot and cold, and within 200 yards water at 74 degrees laden with 33 per cent. of solid matter!

This last statement is one to be questioned, but Dr. Winslow Anderson, in his treatise on Mineral Springs in California, sets down for the spring last named 15,417 grains of chloride of sodium to the gallon. Sea water has only 2,000 to 3,000 grains. Salt Lake has 11,000 grains, and the Dead Sea 13,500 grains, which is the next heaviest laden with salt. Chloride of calcium has 2,364 grains, which, with other minerals, go to make up forty ounces of solids in every gallon.

Such water is, of course, not for drinking purposes, except as an emetic. It is used as a liniment, and for "surprising" people, the spring being named the "Surprise." There are altogether more than fifty springs, each varying in some degree either in temperature or in mineral qualities, and considering the nearness to the City and other conveniences, it is a wonder this remarkable phenomenon has not engaged more scientific attention.

CORLISS ENGINES.*

By J. B. Pitchford, Mem. Tech. Soc.

In speaking of Corliss Engines it is generally understood that the term refers to an engine with a cylinder having four rotary valves, one at each end, to regulate the steam admission, and one at each end for the steam outlet.

The first successful combination of four rotary valves applied to an engine in this way was made by George H. Corliss, some forty years ago. Rotary valves had been used by James Watt, on engines by Bolton & Watt; and Newcomen's engine must have had a single rotary valve, for it is recorded that in the year 1713, a boy named Humphrey Potter, whose duty it was to open and close one of these valves at each stroke of the engine, found it monotonous, and to save himself trouble devised a method of opening and closing the valve by means of tappets receiving their motion from the beam of the engine.

*Read before the Technical Society of the Pacific Coast, Aug. 5th, 1892. Reprinted by permission.

Although the Corliss engine has been in use for the past forty years, there have been but slight changes made in the main principles governing the valve motion. Since the expiration of the patent, Corliss engines have been adopted by many of the leading engine makers in the United States and in Europe, and they still continue to make them in preference to automatic engines of other kinds.

After the verdict of so much practical engineering talent in favor of this kind of valve gear, it would seem that there was hardly a possibility of obtaining anything to supersede the fundamental principles upon which it is devised.

The requirements of a valve gear for a steam engine is to let the steam into the cylinder at the proper time, to cut the steam off at any required period of the stroke, and to let the steam out at or near the termination of the stroke; to have the opening and closing orifices as close as possible to the piston, and at the same time to have these orifices of sufficient size so that the steam will not be reduced in pressure by wire drawing before the cut-off takes place, no matter what the piston speed may be.

It is evident that the orifices or ports can be much smaller with slow piston speeds than with high piston speeds, so that in making comparisons in regard to the clearance space between the valves and pistons of engines, the piston speed and length of stroke should be taken into account. The Corliss valve gear has other advantages besides that of comparatively reduced clearance. On account of the angular position of the pins to the rock plate, there is an accelerated and retarded movement imparted to the valves, and the connections are made so as to take advantage of this movement and thereby obtain a rapid opening of the valves at the early part of the stroke.

Having separate ports for the steam inlet and exhaust outlet must be advantageous, because the incoming steam does not have to pass through exhaust passages which have had their temperature reduced about 100 degrees below the initial steam.

Separate steam and exhaust valves having separate connections admit of considerable adjustment, especially if there is a separate eccentric for the exhaust valves. The steam chests are not excessively large, as on some slide-valve engines, and the valves are not as cumbersome, neither do they take as much power to move them as an unbalanced flat valve of any kind. Theoretically speaking, they only touch the valve seat at a line along the edges of the port when under pressure.

One of the first Corliss engines that came under my notice, twenty years ago, at Virginia City, Nevada, was made by Goss and Adams, of Sacramento, from drawings obtained from Mr. Corliss. It had been running about fifteen years, and at that time we had no mineral oils or valvoline, but tallow was used to lubricate the valves. The salts and acids of the tallow attacked the valve faces of all engines, and those that were run intermittently would wear very fast. The valves in this engine were at that time a sixteenth of an inch smaller in diameter than the hole in the steam chest, yet when the valves were closed and the indicator cocks opened, they did not leak. This shows that the point of contact at the port edges was steam tight.

It is concluded from this that if the valve was tight under these conditions, and it moved easier than a slide valve giving the same opening, that the Corliss valves could be made to move with less friction than unbalanced slide valves. The size of this engine was about 24″×60″, as near as I can remember, yet the valves could all be moved easily with the starting bar.

The Corliss valve motion has also the reputation of governing the engine steadily under varying loads. It is done by a releasing mechanism in most cases, and the point of release is determined by a little cam, the position of which is changed by the action of the

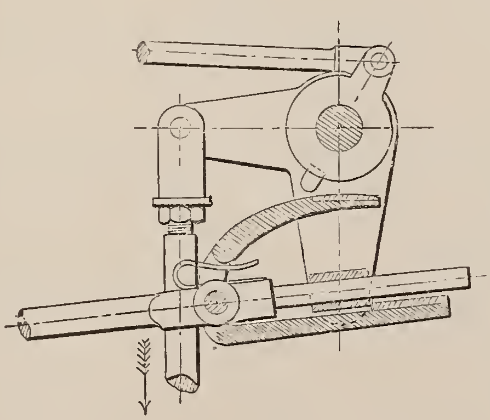


FIG. 1.

HARRIS–CORLISS VALVE GEARING.

governor. One of the first forms of this releasing gear was termed the crab-claw releasing gear, as shown in Fig. 1. It is very effective, and an improved form of it is still used by William Harris, one of the best Corliss engine makers at the present time. Before the introduction of the suction dash pots, the valves were closed by plate springs, the shock being taken by air dash pots regulated with adjustable plug cocks.

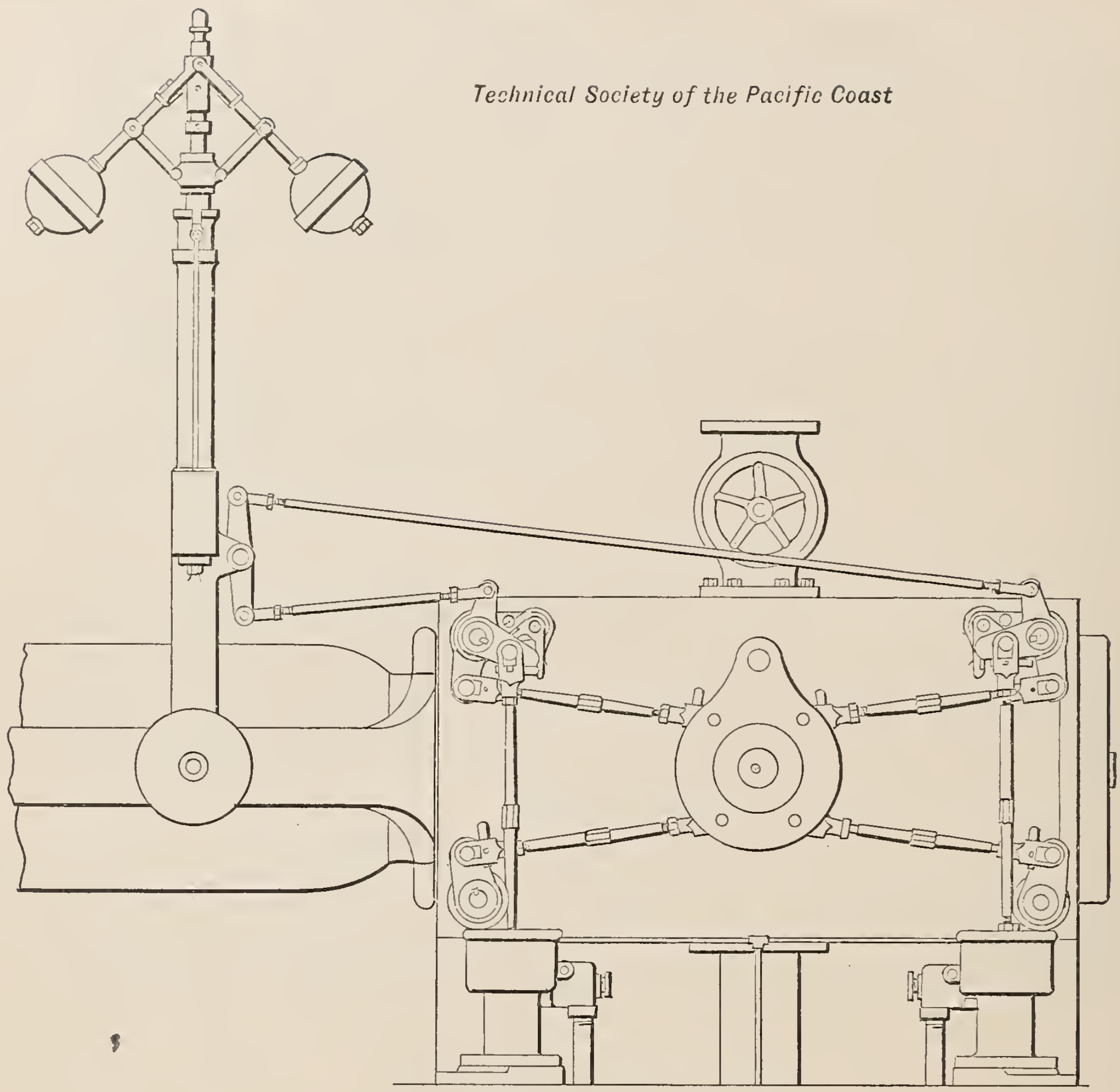


FIG. 2.

REYNOLDS–CORLISS VALVE GEARING.

Fig. 2 shows the hook releasing gear as used on the Reynolds-Corliss, Hamilton-Corliss, and others; but there are several kinds of releasing gear used by other Corliss engine makers. I understand that the George H. Corliss Co. have a new form of release gear, also a modification of the rocker on the cylinder, which gives an alternate accelerated and retarding motion to the valves, also a new application of relief valves.

Some makers of Corliss engines now arrange their pendulum governors with safety devices, so as to shut off the steam in case the governor belt breaks. It is the writer's opinion that belts for driving governors are a little behind the times, and that but a short time will elapse before the leading engine makers will dispense with them. Several large engines have been wrecked in consequence of governor belts breaking or slipping.

Most Corliss engine makers have adopted a modification of the girder frame introduced with the first Corliss engines, some of them using flat guides and some of them retaining the original V guide. Some of these frames have been built without a holding-down foot at the end of the guides, and this is found to be a defect in instances where the engine was run up near its full capacity. This form of frame will require to be strengthened if used for engines running over 100 revolutions per minute, and doing hard work. A frame with circular bored guides has the advantage of allowing the cross-head to run free if the engine shaft is not horizontal. The author has found a modification of the Porter-Allen frame to be well adapted for high speeds.

Some Eastern makers of engines retain the small sizes adopted, for crank pins, cross-head pins, and valve-gear pins, when it was customary to run at lower speeds. This cheapens the work, but it is evident that an engine with small wearing surfaces cannot last as well doing heavy work as one with ample surface, and as the tendency is now to increase speeds the surfaces will also have to be increased.

The August issue of the Magazine *Industry*, shows that Mr. S. S. Webber, of the Trenton Iron Co., has written a letter telling of a 20″×42″ Corliss engine having a releasing valve gear, and running at a speed of 160 to 170 revolutions per minute. This is something extraordinary for a releasing gear. I should have thought it impossible to avoid the shock that apparently would be caused by the sudden contact of a moving part coming at a high velocity against the inert mass represented by the valve when disengaged. If Corliss engines can be run successfully in this way to suit general manufacturing purposes, it is strange that the Corliss Engine Company, and other makers, still continue to rate all their engines at speeds below 100 revolutions per minute.

Since the introduction of electricity there has been a demand for higher speeds with economical engines. The difficulty that presented itself was to obtain both results with the same engine. There are plenty of high-speed engines that fail when it comes to a comparison of economy with a good Corliss engine.

We do not depend upon isolated tests under some peculiarly advantageous circumstances, to illustrate the durability and economy of well-made Corliss engines, there are at least a score of first-class engineering firms who can produce records of tests, made by unbiased competent engineers, of engines they have made. And

RESULTS OF CORLISS ENGINE TESTS.

Name of Maker.	Tested by	1st Cylinder.	2nd Cylinder.	3d Cylinder.	Revolutions per Minute.	Steam Pressure.	Pressure in 1st Receiver.	Vacuum.	Duration of Trials, Hours.	H. P. Developed—1st Cylinder.	H. P. Developed—2nd Cylinder.	H. P. Developed—3d Cylinder.	Total Horse Power.	Lbs. Coal per Indicated H. P.	Lbs. Water per Indicated H. P.	Remarks.
Wm. A. Harris	Geo. H. Barrus	22x60	44x60		68	113	8	25.6	60	312	307		619	1.69	*14.31	Tandem. *Includes 600 lbs. Water for Jackets.
Wm. A. Harris	John W. Hill	16x48				74.4			8				72.3	2.57	23.13	High Pressure.
Watts, Campbell Co.	John Young	20x48	36x48		64	80		27	96				297.5	1.73		Tandem Compound.
Reynolds	E. D. Leavitt & Henthorne	14x48	25x48	33x48	99.1	125		26.5	10				515.7		12.94	Jacketed Cylinders. Independent Condenser.
Reynolds	Remington & Henthorn	18x42	32x42			98				109.6	124.1		233.7		13.26	Cross Compound.
Reynolds		19x48	38x48			102		26	24				325.4		14	Jet Condenser.
Reynolds	B. H. Fiend	27x60	46x60	70x60	16.6	124	25.8	27	8	389					12.67	Triple Pump Engine Jacketed.
Payne		20x28			120									2.64		High Pressure.
Corliss Steam Engine Co. Providence, R. I.	Richard Borden Mill Fall River	20x60	34x60	two 36x60	65.8			27.3	61.4	353.54	329.78	two 380.13	1063.	1.445		Triple Expansion. Four Cylinders. Double Tandem.

it is shown that Corliss engines, about 18″ × 48″, running at 600 feet piston speed, can run high pressure on from 20 to 22 pounds of steam per indicated horse power per hour, and on 16 to 17 pounds of steam when condensing. Engines of this size are built with clearances of from 2 to 2½ per cent. between the valves and the piston. The Watts-Campbell Co. say their high-pressure Corliss engines will run on 3 pounds of coal—2¼ pounds condensing; $1\frac{7}{10}$ pounds compound condensing, and 1½ pounds triple expansion.

There is subjoined a list of trials of Corliss engines, which were obtained hurriedly, and do not set forth as being the best obtainable; it will be observed that a triple-expansion Corliss engine has developed a horse power on about $1\frac{44}{100}$ pounds of coal per horse power per hour. This is coming near to the best results of the best type of triple-expansion marine engines, whose records are generally made under more favorable circumstances than land engines, in consequence of the proportions of the cylinders being made to suit a uniform boiler pressure, with the uniform resistance of a propeller acting as a hydraulic brake, and tested generally with the best kind of coal.

The transatlantic marine engine practice, during the past twenty years, shows that the right road to economy in the use of steam is by making triple-expansion and quadruple engines. These eminent engineers of extensive experience evidently add additional cylinders for the purpose of maintaining equable temperatures, and this is following the advice given by James Watt, who did more than any one engineer to enunciate the fundamental principles of the steam engine. He said: "keep the cylinder as hot as the steam that you are going to put in it," and it is evident this is not done when an engineer undertakes to make too many expansions in the same cylinder, and it demonstrates that with high pressures, triple expansion must be preferable to two cylinders, and that steam jacketing is one of the essentials.

The duty of pumping engines has been increased materially by the introduction of the Corliss valve gear. A high pressure geared pumping engine at Madison, Wisconsin, has a record of over 71,596,000 pounds raised one foot high with 100 pounds of coal. The compound condensing pumping engines at Milwaukee have a record of 104,820,431 pounds raised one foot high. It was somewhat surprising to learn that this method of rating the duty of pumping engines was introduced by Bolton and Watt over 100 years ago, the only difference being that they used the English hundredweight of coal, 112 pounds. It appears that they were paid in proportion to the coal their engines saved.

It is noticeable in most branches of engineering that whenever it is essential to have a really first-class economical steam power, that an engine having Corliss valves is selected. The large Ingersoll-Sergeant duplex air compressors are run by Corliss engines. The largest refrigerating machine, built by the De La Vergne Refrigerating Co., is driven by a Cross compound Corliss engine, 32″ and 64″ by 48″ of 600 horse power. The Frick Co. furnished a 750 horse power, tandem compound condensing Corliss engine 30″ and 44″ by 48″, for the Tacoma Electric Railway and Motor Co. It has a fly wheel 25 feet diameter, weighing 50 tons, and runs 65 revolutions per minute.

A Harris-Corliss compound steam engine at Fall River, Mass., is 28″ and 52″ by 72″, and runs 56 revolutions per minute, with a fly wheel 30 feet diameter, and 96 inches face. The steam pressure is 125 pounds, the rated horse power 1,100, and the rim speed of the wheel is 5,281 feet per minute. The Corliss Steam Engine Co. have made a quadruple expansion engine coupled at right angles, with 24″ and 52½″ cylinders on one side, and 36″ and 64½″ cylinders on the other side, arranged tandem. The fly wheel is 32 feet diameter, 114 inches face, and makes a rim speed of 5,278 feet per minute.

It appears to be the practice with some makers of Corliss engines to make their fly wheels weigh from 80 to 100 pounds for each horse power developed by the engine when cutting off at one fourth stroke with 80 pounds of steam. The Philadelphia Engineering Co. advocate 150 pounds of metal in the rim of fly wheels for electric railway engines, 75 to 100 pounds for electric light engines. Of course, it is understood that the rim weight can be reduced with tandem engines, especially if in pairs.

Some of these engines are mentioned to show what large fly wheels are necessary to give the required belt speed to transmit the power, and to show the advantage of increasing the speed of Corliss engines in order to reduce the size of their fly wheels as well as other parts of the engines. For electric purposes dynamos can be constructed with revolving field magnets to take the place of the fly wheels, and these can run at 150 or more revolutions per minute, and it will certainly make an economical machine if driven by a Corliss engine direct. For these and many other reasons the author advocates increasing the speed of Corliss engines, and thinks that a non-liberating valve gear is better suited to high speed, than anything that can be made with a liberating device.

In 1885 the author designed a non-detaching Corliss valve gear, with a governor on the engine shaft, and, in his opinion, it was the first time the governor of a Corliss engine was used that way. The engine was made by Mr. W. T. Garratt, and placed in the Mechanics' Fair in San Francisco, where it ran a competitive test with other engines in regard to steam consumption, and the judges awarded it the gold medal, the highest premium for the best and most economical steam engine.

Technical Society of the Pacific Coast.

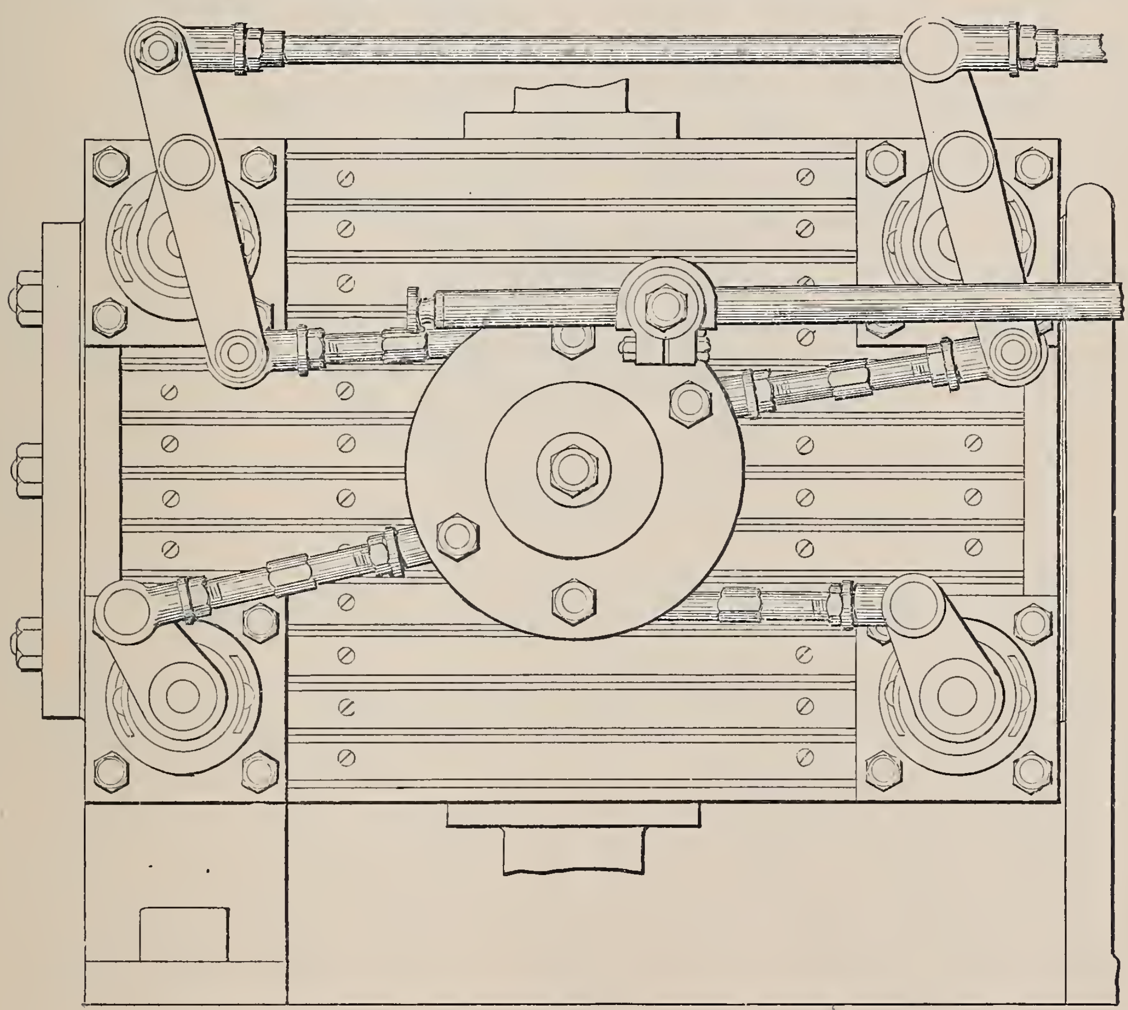


FIG. 3.

PITCHFORD-CORLISS VALVE GEAR.—ENLARGED VIEW.

This engine was constructed with a cam motion, in a manner similar to that shown in the drawings in Figures 3, 4 and 5. The motion to the rock plate on the side of the cylinder was imparted by the main eccentric in the ordinary way, with the exhaust valve connections the same as other Corliss engines; but on the arms of the steam valve stem there was suspended a floating lever, at a point between its two ends. The lower end of this lever received motion from the rock plate, and the upper end received motion from the cam on the engine shaft. The cam was formed of two concentric semicircles of different diameters blending into each other, and in revolving in contact with rollers on levers connected by rods to the upper end of the aforesaid floating levers, a motion was imparted at the proper time for closing the steam valves.

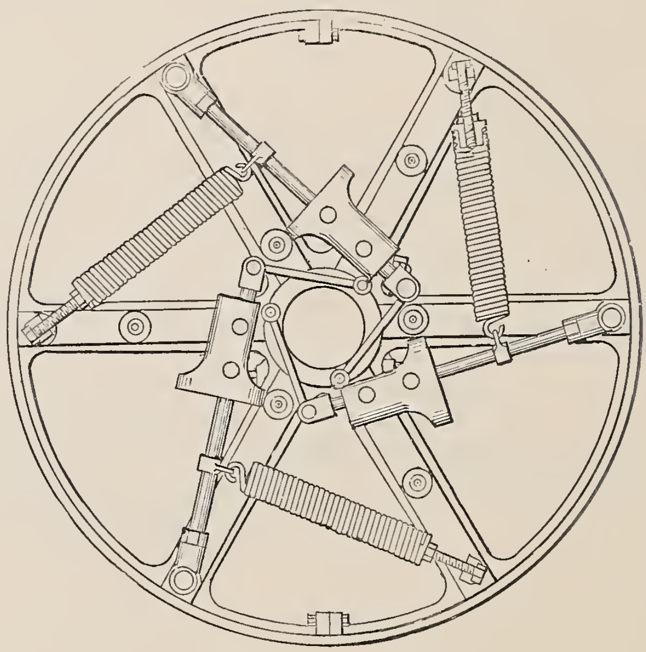


Fig. 4.

Pitchford–Corliss Valve Gearing.—Governor.

When the governor weights flew from the center by any acceleration of speed, the cam was advanced on the engine shaft, so that the steam was cut off earlier.

Another method employed by the author for imparting motion to the floating levers on the steam valve stem, is by means of bell cranks receiving motion from an eccentric, the angular position of which, is determined by the governor on the engine shaft, which advances this eccentric as the speed of the engine increases. The illustrations on page 186 will serve to explain this valve motion.

Sixteen of these engines have been made: thirteen by W. T. Garratt & Co., and three by the Phœnix Iron Works, in this City, and the author possesses good testimonials from the parties who are using them. One of these engines ran for over three years at a speed of 150 revolutions per minute, without a dollar's worth of repairs.

Francis Smith & Co., reporting upon one of these engines, say:

"The Pitchford Corliss Engine, 12″× 20″, at our electric light station in Watsonville is running 160 revolutions per minute. It runs a 650 light Thomson-Houston dynamo 1500 revolutions per minute. We have a water wheel in conjunction with the engine, and by means of a friction clutch coupling connecting our counter-shaft, we can run the dynamo with either steam or water power, at a moment's notice, and make the change while running, without causing the least flicker in the incandescent lights. We can also have engine and water wheel both running at the same time and then shut the water off the wheel without changing the speed of the engine, owing to the perfect regulation of the automatic governor. The engine is noiseless, and it takes very little fuel to run it, and in every way it gives good satisfaction."

This engine held its speed with 35 pounds variation in boiler pressure when working up to 40 horse power, when tested by Max Caspari, electrical engineer, and A. White, the company's superintendent at Watsonville.

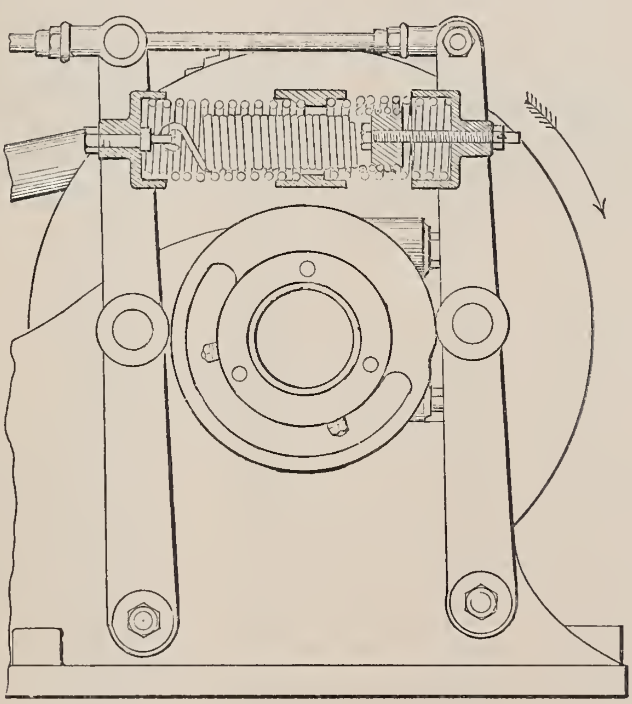


FIG. 5.

PITCHFORD–CORLISS VALVE GEARING.—ECCENTRIC.

One of these engines can be seen at a boot and shoe manufactory, in San Francisco; it is 12″× 24″, and runs 120 revolutions per minute; and has been in use 10 hours a day for over three and a half years, consuming a little more than three pounds of coal per horse power per hour.

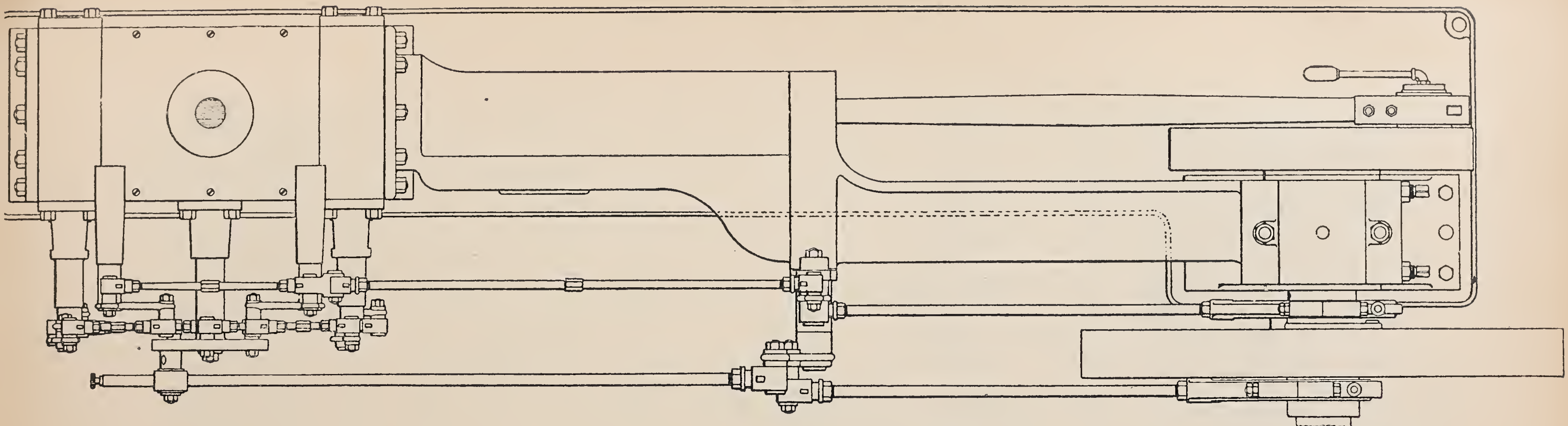


Fig. 6.

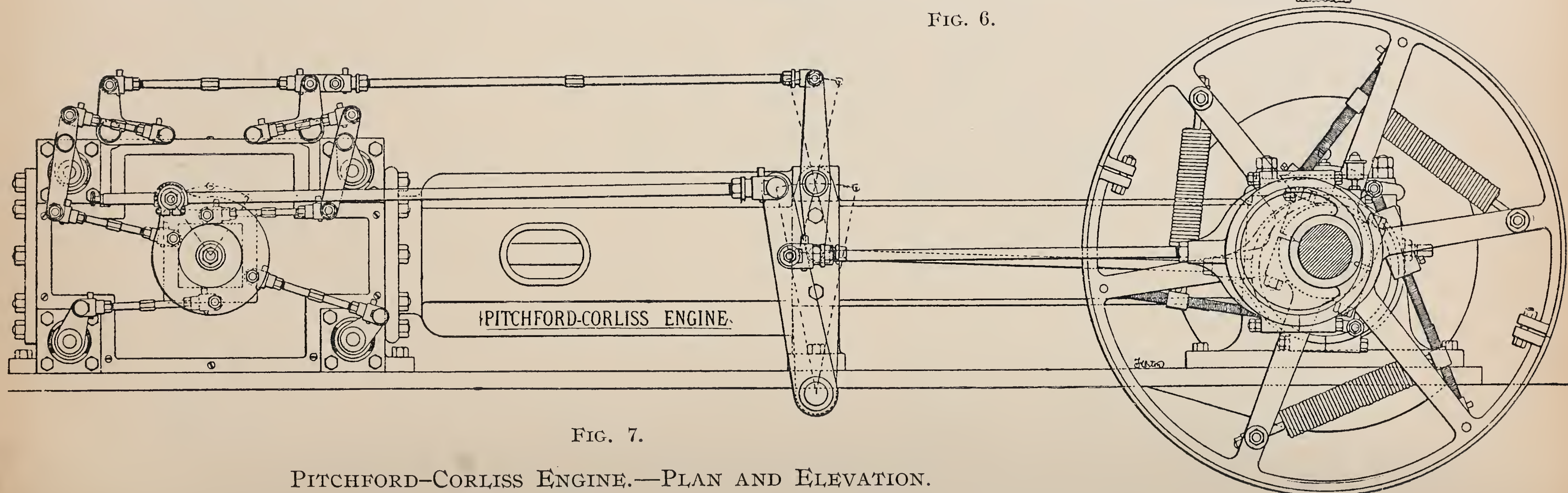


Fig. 7.

Pitchford-Corliss Engine.—Plan and Elevation.

These three engines are referred to because it is found that quite a number of people in the engineering business are not aware that the Corliss engine can be run at a speed of 200 revolutions a minute.

A more detailed explanation of one form of this valve gear can be seen in the June number of *Power*, and a copy of a working drawing from which the 14″ × 24″ engine, now running the electric lights in Redwood City, was built, can be seen in the Magazine *Industry* for February, 1892.

TIN-PLATE INDUSTRY.

In two separate reports of a tin plate works, the Anderson Company in Indiana, we learn the following particulars:

Report to Government.—"Began manufacturing Dec. 1891. Use American plates. Have two Morewood tinning stacks (*sic*). Estimated investment $20,000. Yearly capacity 4,000,000 pounds."

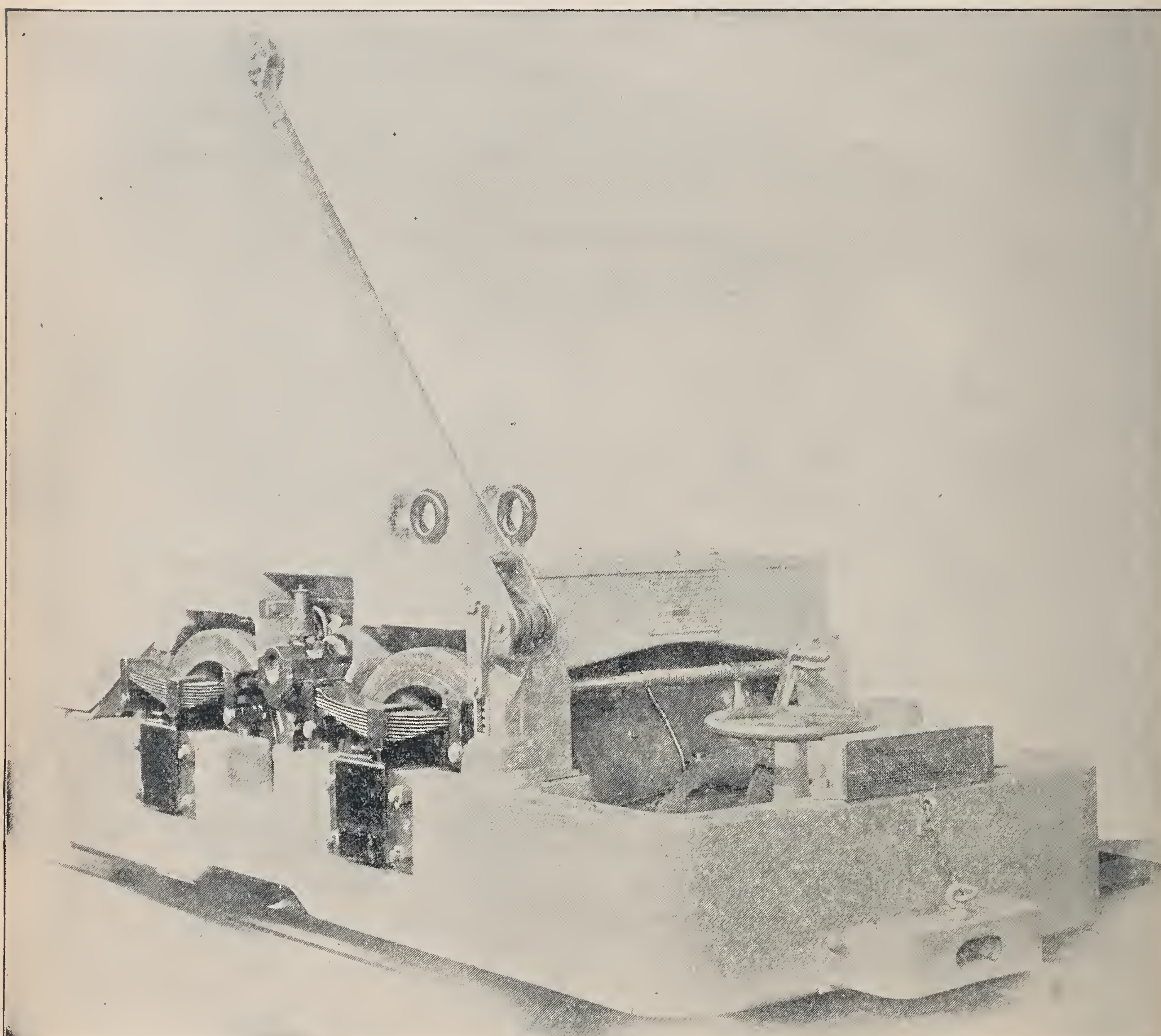
Report by another source.—"The two tinning pots are worth $1,250. The Anderson Co. never used any American plates. The works were sold out on the 6th of July last by the sheriff for a mechanic's lien of $181. The Company owes H. Whitmore of New York $700 for imported black plates."

Here is a contrast!

It is time some truth came out of this tin-plate literature. We suspect that the main purpose of the increased duty is to favor galvanized iron plates, and other than tin sheets. It seems the thin sheets or black plates, as they are called, on which tin is laid, are mainly imported, and as we have this far unfortunately no tin to speak of in this country, our part in tin-plate manufacture is tinning the plates, which is, by all accounts, a very undesirable kind of industry, being unskilled, underpaid and very unhealthy.

For two years past we have not dared to print any news, or even to reproduce explicit statements respecting the tin industry, and see, at this time, no hope of doing so in future. The nine months' time allowed for the importation of large quantities of tin-plate beforehand to evade the new duty, indicated a questionable object of those people who are foremost in talking of tin-plate making.

We have been going through various exchanges for two years past, to find a responsible essay on the subject by any scientific man of standing, or anyone with knowledge of the subject, whose views were disinterested and reliable, and have found none.



ELECTRIC MINING LOCOMOTIVE.

THE THOMSON-HOUSTON COMPANY, BOSTON, MASS.

The Company sends the plate above, representing one of the latest of their designs for electric mining locomotives. The electric engineers and makers of power machinery, have in their locomotive designs, not only to go over a field of evolution, as in the case of common traction locomotives, but an adaptation which calls for special designs in almost every case. For example, the Thomson-Houston Company are constructing locomotives of forty tons weight to be operated in railway tunnels with free scope for dimensions, while in the present case the "contour" has to be crowded into the limited cross section of a mine tunnel.

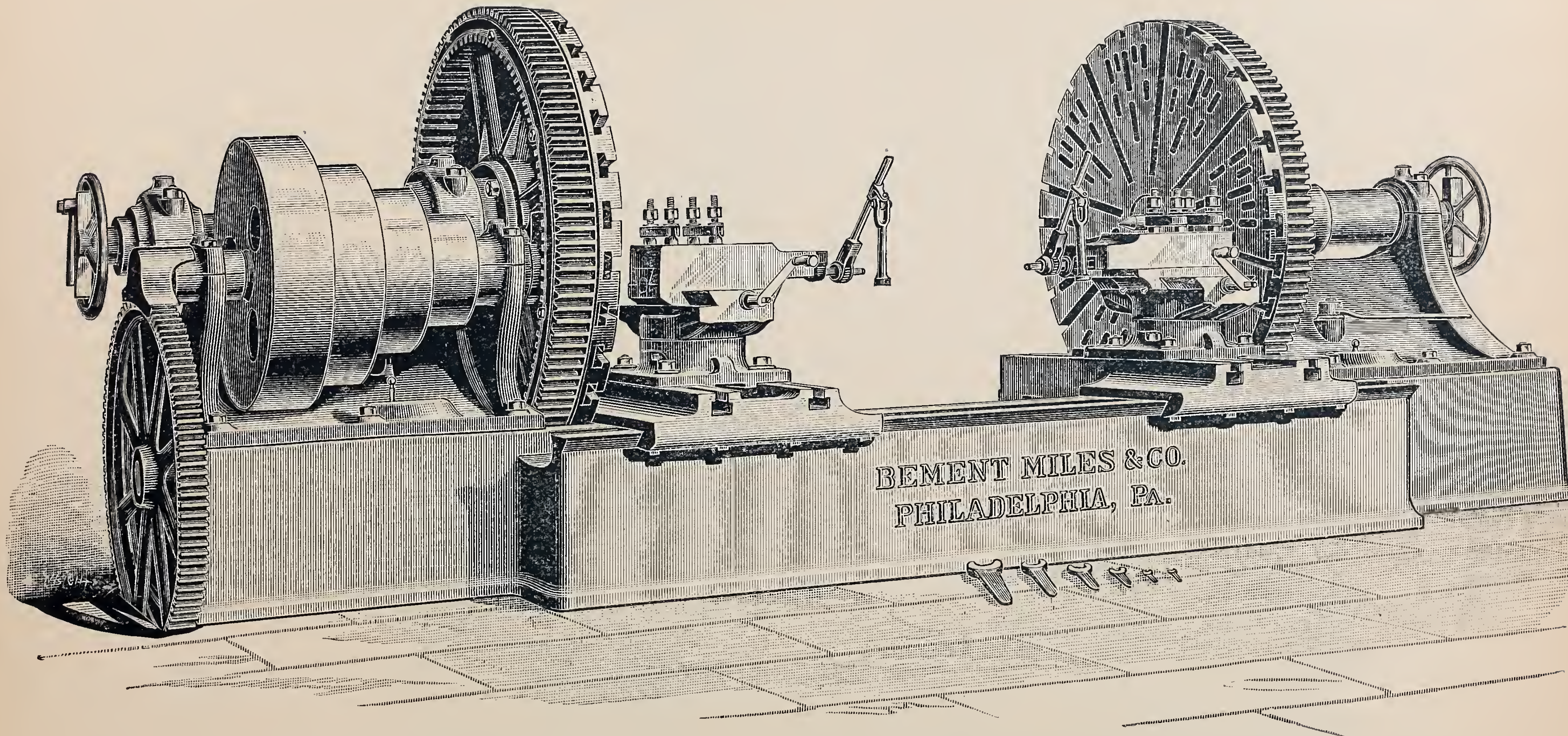
The present design varies a good deal from the "terrapin back" one familiar to most of our readers, and is more securely guarded by its ponderous framing and general arrangement. New features as follows, may be mentioned. The top pole piece forms a complete protecting cover for the motor. The motor is geared to both axles so as to dispense with side rods. The trolley staff is insulated and may be handled from any point. The trolley is mounted in a socket and may be set on either side of the machine; with many other changes from previous types. The main points of interest to mining people are tractive force, maintenance, and manipulation. These, they understand, and are quite content to leave electric technicalities to the makers who are responsible for "functions."

The following particulars apply to the locomotive shown, adapted for a gauge of 30 inches.

Draw-bar pull	3,000 pounds.
Speed	6 or 10 miles per hour.
Length over all	9 feet 6 inches.
Total height	36 inches.
Width over all	48 "
Wheel base	40 "
Gage	30 "
Diameter of wheels	28 "
Weight	15,000 pounds.

The tractive force of these locomotives is varied from 750 to 4,500 pounds.

Mr E. H. Booth of the Company, was recently in San Francisco, after some months of observation in the mining districts of Lake Superior and Montana. His views have interest and importance, the latter because of his consummate knowledge of the practical requirements in mining which few electrical engineers can ever hope to attain. We hope to present at some future time conclusions of his respecting the possible position that electrical apparatus may assume in our mining industries on this Coast, where but little has this far been done in proportion to the field to be operated in.



New Double Driving-Wheel Lathe.—Bement, Miles & Co., Philadelphia, Pa.

NEW DOUBLE DRIVING-WHEEL LATHE.

BEMENT, MILES & CO., PHILADELPHIA, PA.

The engraving opposite is a drawing in perspective of a double lathe for turning locomotive driving wheels, an operation that is not only in its nature one of the heaviest, but is done at a rapid rate, and the "resistances" to be provided for call for massive proportions and good fitting.

The spindles and face plates, or heads they are called, are alike at each end, and capable of operating together, that is, wheels can be turned at each end at the same time, or either head can be operated, the other performing the functions of a tail stock.

The main spindles are hollow and fitted with supplemental bars that can be set out by the hand wheels seen at the rear, so as to produce the required overhang when the wheels are turned with the crank-pins in place. This avoids the "spring" of projecting centers.

The design is massive, plain and complete, and meets the requirements set up by Mr. Miles, of the firm, who ten years ago assumed that the time consumed in cutting off or turning up the steel tires of locomotive wheels, was a matter of "compensation" or strength of the tools employed.

The variation of conditions under which metal turning is done, are such that no one without experience can conceive of them. From soft iron or steel of a few inches in diameter, to a chilled roll 16 to 24 inches diameter, or a locomotive wheel six feet in diameter, is such that the operation can hardly be classed as the same process. Locomotive tire turning comes much nearer to turning on chills than soft iron. In fact, the lathe shown could be employed on "chills" if the work could be held on centers.

The feed of the tools for the lathe illustrated is from an overhead oscillating shaft, and while to the unskilled it may seem a crude method, it is in fact the most complete ever invented, acting at all angles, capable of complete adjustment, above the dirt and chips, and when not in use is entirely out of the way.

Messrs. Bement, Miles & Co., or the "Industrial Works," as they are called, are among the most famous in this country, and as a machine-tool works, in many respects the principal one. They were founded about thirty-five years ago, on their present site, or on grounds included in the present site, with Mr. W. B. Bement as senior partner and engineer. About eight years later the main works and offices were rebuilt in a manner excelling any thing of the kind in this country, and have recently been again remodeled to equal in their appointments any in the world.

The firm, formerly Bement & Dougherty, in their practice as general machine-tool makers, besides assuming a superior excellence for all their work, took cognizance of practice all over the world, and maintained a rank of the highest class in every way, as their tools in nearly all of the machine works on this Coast will attest. No inferior or second-class work of any kind was ever made in the Industrial Works. The methods do not permit it. Mr. C. S. Bement, the present senior member, was raised in the works, so to speak. Mr. F. B. Miles, the chief engineer, was first engaged there in 1866. The staff has always embraced the highest talent, and the whole has been one of the best examples in the development of American skilled industry.

These notes are set down from memory, and the dates may not be in all cases exact.

THE TECHNICAL SOCIETY.

The following new members, having been balloted for, were declared elected :

H. E. Clermont Feusier, U. S. Geological Survey. . San Francisco, Cal.
William A. Doble, Mechanical Engineer.......... San Francisco, Cal.

Two names were proposed for membership, and referred to the Executive Committee.

Mr. Mark B. Kerr, of the U. S. Geoglogical Survey, then read a paper entitled the "Geographical Position and Height of Mount St. Elias," in connection with which he related some very interesting experiences encountered in making an ascent of the mountain, while engaged in taking observations for the U. S. Geological Survey. A number of lantern slides were exhibited, showing Elias from various directions and heights, and illustrating the vicinity of the mountain, its prominent glaciers and moraines.

The discussions of the papers, read at the last meeting, being in order, it was agreed, upon motion, to postpone these discussions until the next regular meeting of the Society in order to give the members more time to prepare for the subjects under consideration ; one being

"Corliss Engines," read by John B. Pitchford, M. E., and the other "Elevator Tests," by Professor H. B. Gale.

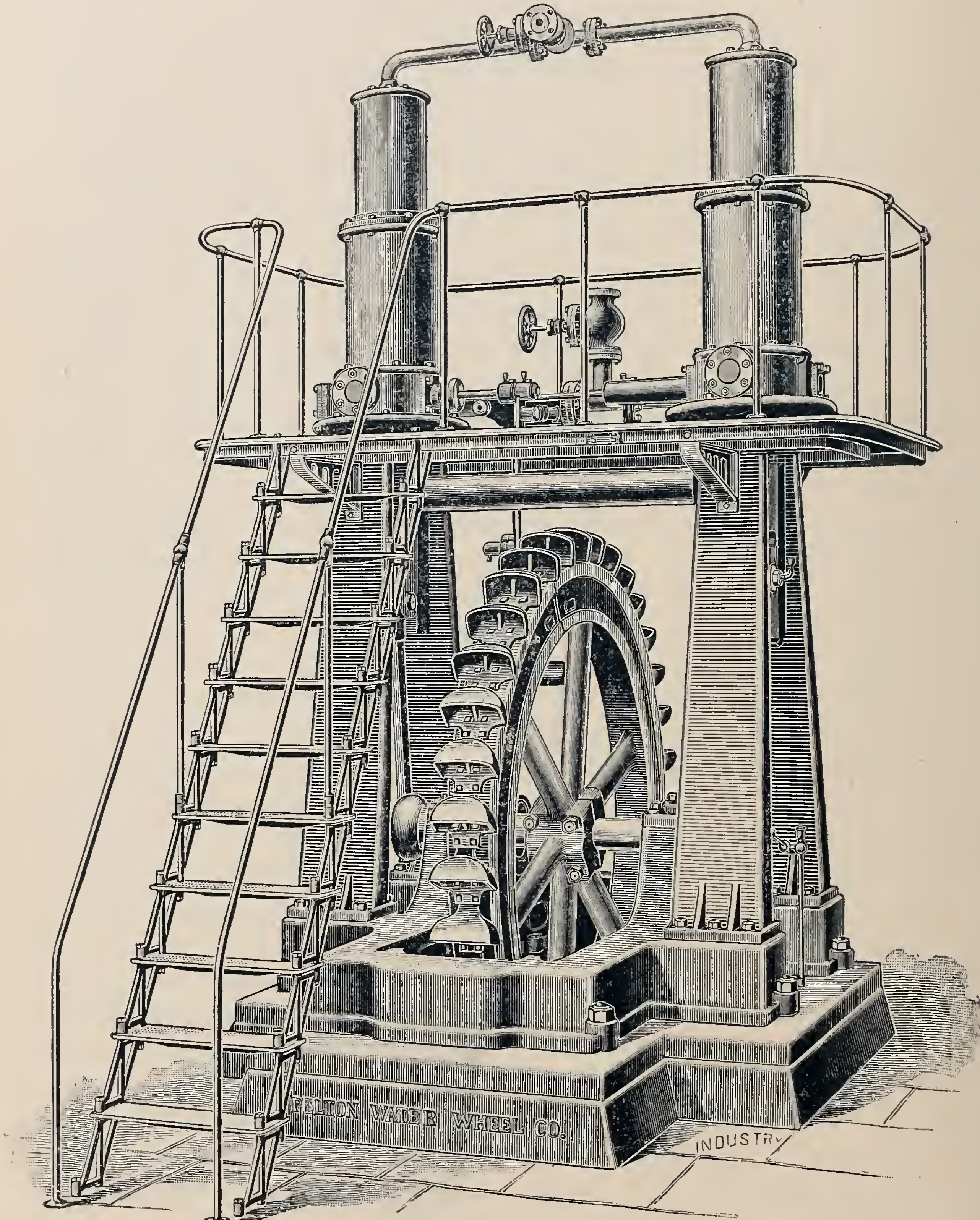
Mr. C. E. Grunsky remarked that one of the papers of the Technical Society had been published by another serial before appearing in the Transactions of the Society, and that no credit had been given to the Society in this prepublication. He suggested that in future the manuscript property of the Technical Society should not be allowed to appear in any other publication without consent, and that due credit should be given wherever copies of original papers are made, either by extracting therefrom, or by republishing the whole. Mr. W. D. Johnson moved that the subject be referred to the Board of Directors for advice, which was done accordingly.

The matter of the Engineering Congress, to be held in Chicago in 1893, was brought up, and the proposition discussed as to the papers that would be submitted from the Pacific Coast on technical subjects.

In this connection Mr. Grunsky said that the Secretary of the American Society of Civil Engineers had written him to suggest the names of such parties who would be the most likely to present papers to the Congress on the most suitable subjects. He, as a committee from this Society, properly qualified, had suggested certain names and subjects, and the Secretary of the American Society had written him that the gentlemen, hereby proposed, had been duly notified of the object in view. The meeting in Chicago is to be held for one week only. Mr. Grunsky said that he would be pleased to receive any suggestion in regard to this matter, and that he would at once communicate with the Secretary of the American Society.

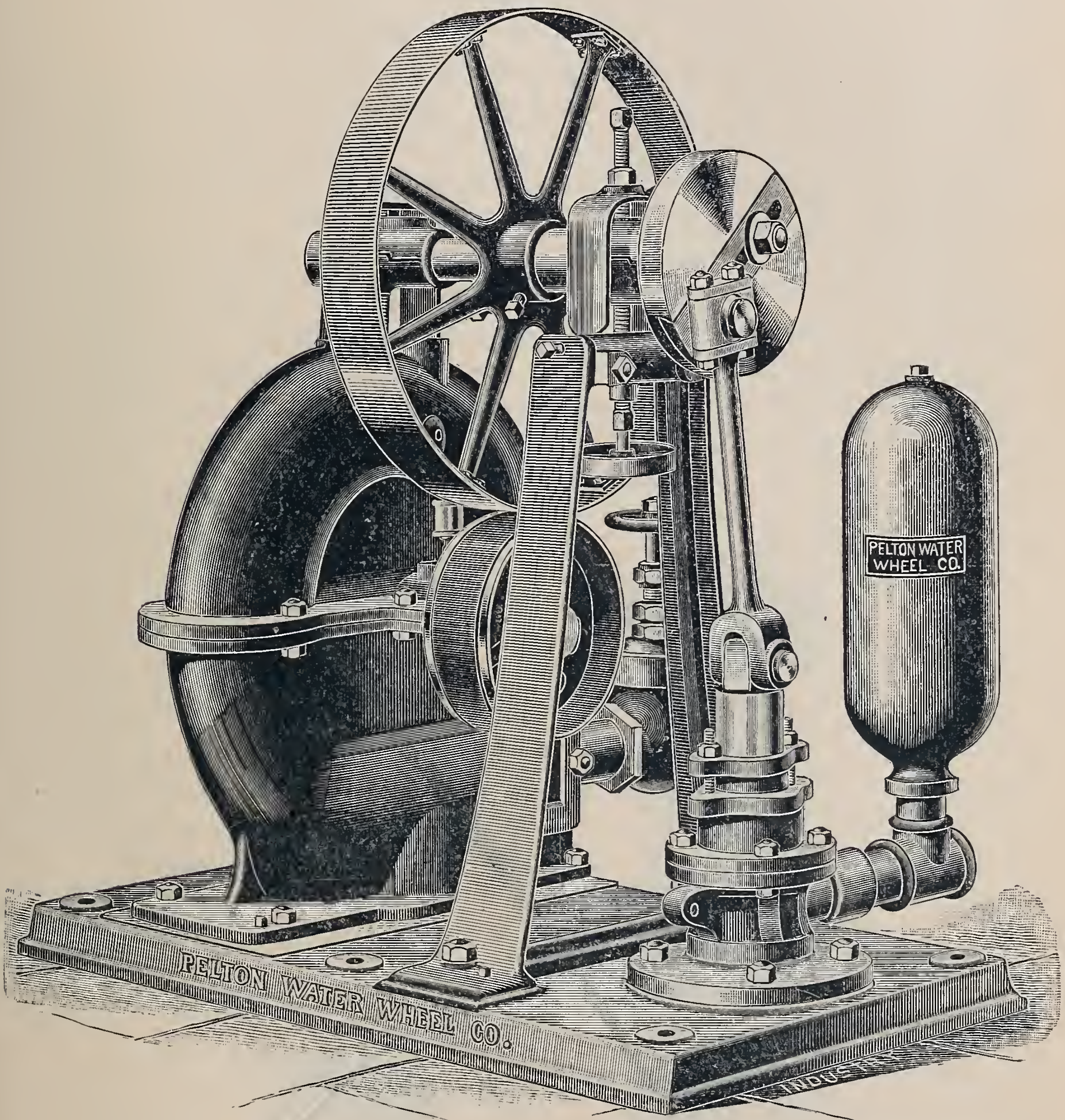
It was asked by Mr. Dickie that Mr. Grunsky communicate with the Secretary of the American Society of Civil Engineers, or with the Secretary of the Engineers' Congress, and ascertain whether the invitation to the Technical Society should not include all the members, and embrace the different engineering professions represented among them.

At the next regular meeting, on Oct. 7th, Mr. C. A. Stetefeldt, E. M., member of the Society, will read an interesting paper on the "Curriculum of a Modern College — Classics *versus* Natural Scienes." Ladies are invited to attend this meeting.



PELTON WATER WHEEL AND DOUBLE AIR COMPRESSOR.

THE PELTON WATER WHEEL CO., SAN FRANCISCO.



PELTON MOTOR AND FORCE PUMP.

THE PELTON WATER WHEEL COMPANY, SAN FRANCISCO.

The Pelton Water Wheel Company find a considerable portion of their business to consist in adapting and combining their wheels for various specific purposes, and in a majority of such cases find that the cheaper and better construction consist in making the motors an integral part of the machines. This calls for combinations with dynamos, pumps, separators, and many other machines that are mounted with the wheels on a continuous sole plate, so that when sent out from the works there is nothing for the purchaser to do but to provide a foundation of some kind and "connect."

The design shown is for pumping, and the drawing so complete that description is unnecessary. The pumps are driven by friction gearing, and are arranged with a variable stroke so the amount of water raised can be adjusted to the power of the wheel, and the head pumped against.

Another and more extensive combination of the kind is shown on page 788, where a Pelton water wheel and double air compressor are combined. The result, as may be seen, is a complete symmetrical machine, one of low first cost and high efficiency. There are many combinations of the kind, but the two presented are typical and of late design.

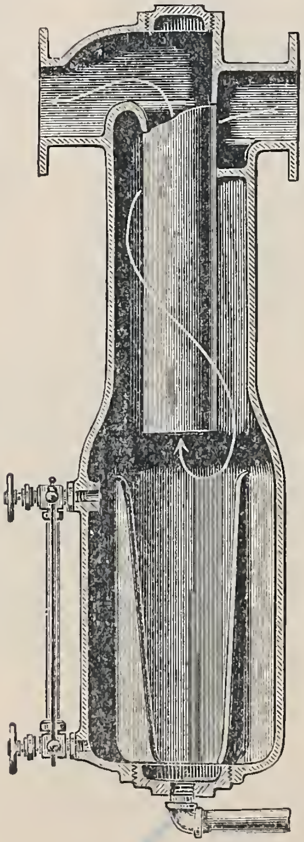


FIG. 1.

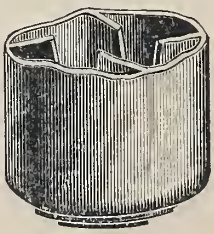


FIG. 2.

THE IMPROVED STRATTON SEPARATOR.

The "separator" is one of the latest adjuncts to a modern steam power plant, an important one, performing, as it does, a very useful function without moving parts, wear, or requiring attention after once being put in place. The object is to separate from the steam, on its way from the boiler to the engine, entrained water, waste oil, or any substance of greater gravity than the steam itself.

The present one, shown in vertical section at Fig. 1, is based on the fact that if the steam is given a rotative or whirling motion, any substance in suspension, heavier than the steam itself, will, by centrifugal force, flow at once to the periphery, or against the walls of the vessel in which the steam is confined, and thus permit separation and removal. This rotary motion in the vessel will, however, when the flow is strong, retain the separated water or oil in a revolving stratum around the interior of the vessel, leaving a free way in the center for the steam to escape at the drain pipe.

In the present invention this centrifugal action, after performing the function of separation, is arrested by means of helical vanes set around the collecting chamber at the bottom of the main vessel, the angle, with respect to the axis of the vessel, being such that the separated elements come to a state of rest, or nearly so, at the lowest point, and may be drained off there.

The form and position of these vanes are shown in Fig. 2, which is a broken section across the middle of the lower or collecting chamber of the apparatus. The method of construction, and obvious opertion, of this separator seems to attain all that is possible in such apparatus, and its working has been very fully proved in practice. The San Francisco Tool Company, of this City, are agents for the separator here, and have various sizes on exhibition at their works in Stevenson Street.

JIM STACKPOLE'S RANCH.

A MINER'S YARN.

I don't know as you are aware, stranger, that this country is pretty much dug over, not but what it shows it now, but the people and the sluices are gone. Why I've seen this cañon when it looked like an ant's nest, an' it paid in a way, that is gold was got and gold was lost, perhaps it was best left underground.

After minin' come farmin', that is what they call farmin', but it was mere excuse for these old miners to exist and stay in the neighborhood. They couldn't get away, so no one 's to blame. The farms are a joke ; fifteen to fifty shaggy fruit trees not trimmed or worked. A garden patch, and a cabin of one room. The boss down at Solomon Isaac's store, settin' on box waitin' for some one to treat, and for the mortgage on his land to come due, when he will get twenty-five to a hundred dollars to clear out with, and that's the end, stranger.

I tell you a miner won't work except at minin', and he must have his way about that. There was Jim Stackpole as had that place roun' in the cañon there, a goodish place for fruit or anything, if it were worked. Jim dug a well, that was natrel to him, and then quit, and hired a Norwegian, about six foot three inches long, to do the work. Jim undertook the "administration," as he called it. That meant sittin' under a tree watchin' the Norwegian till noon, and then going down to Bradleys in the afternoon to look for drinks and spin yarns.

Jim concluded he would "go into fruit," and along in the Fall begin diggin' holes for trees, that is he staked out, the Norwegian dug the holes. The ground was hard as quartz, and the work went very slow till Jim thought of blasting out the holes, and went over to the Pocahontas and borrowed a bundle of "giant" and some fuse. He got an old auger, and would bore down about three feet, and put in from three to six inches of giant. It done the business, Jim's wife came out at the first round and said it knocked the dishes down, "but these," says Jim, "are no good until I get returns, there is nothing much to eat out of them." The giant raised up little mounds, and loosened things generally. It goes downward, you know, mainly, and the Norwegian got bold and would stand near, when a blast went off, to show he was not afraid.

Jim always had a little of the devil in him when there was fun at hand, and about noon, when they crossed a little gulch, the Norwegian said he struck a rock with the auger. Jim hollered "that 'll do Olsen, give her six inches of powder." He knew well enough, the old scamp, that Olsen had struck the cliff, and when the fuse began to smoke Jim moved around behind the cabin. Heavens and earth! When that blast went off it was like one of them Frisco powder-works explosions.

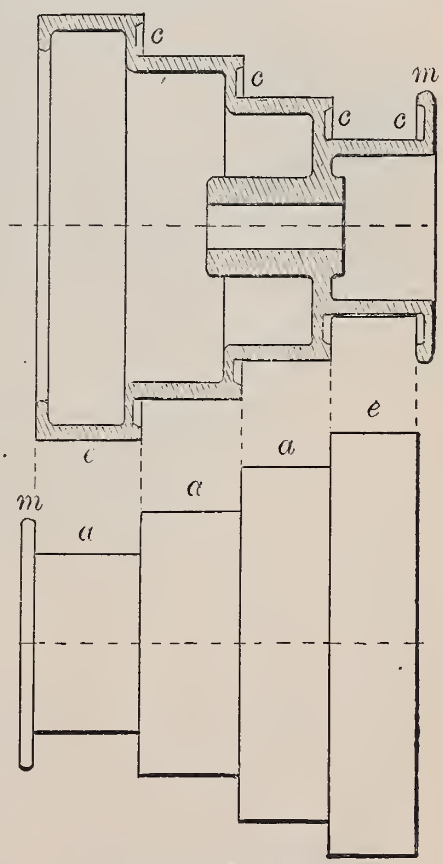
There was about fifteen tons of earth and stones started off in all directions. The wind struck the Norwegian first and flattened him down so the charge went over him, but Jim's cabin were riddled with stones, and gave the old woman "sterricks." When she come to, Jim had to leave, and don't you think that cuss went down in the Sacramento Valley, and went to blowin' out tree holes on the ranches at two bits a piece; paid off his mortgage, planted more trees, and now has a six-room, painted house, and is the laziest man in the district.

CONE, OR STEP PULLEYS.

[FROM A MANUAL OF MACHINE CONSTRUCTION.]

These are employed for altering the speed and power of machines, especially machine tools. They are an important factor in belt transmission, and perform a function not easily attainable by other means. In the common text books may be found many intricate formulæ for computing the diameters, so as to attain uniform tension of the belts, and but little other information of use in constructing such pulleys.

When there are two cone pulleys of different size, the best way is to set the patterns at their working distance, and measure around them with a tape line until they give a uniform length on each step, keeping the different steps on the same pulley as uniform as possible. In finishing the first pair the same method can be followed, marking the diameters permanently on a gauge, to which calipers may be set in future cases. This is not scientific, but it is practical, and moreover, secures exactness without risk and at the least expense.



CONE PULLEYS.

The drawing shows a method of constructing cone pulleys, employed by the author in his practice for many years past, and believed to have many advantages. It is the invention of Mr. F. B. Miles, of Bement, Miles & Co., Philadelphia, and was adopted in his practice about 1870. The faces at *a*, *a*, *a*, are made flat or parallel. Those at *e* are made slightly convex. The radial faces at *c* are recessed. Flanges are employed on one end at *m;* none are required for the large pulleys *e e*. These flanges are recessed as shown in the drawing. In years of use none of these cone pulleys have ever injured the edges of belts, while, as may be seen, the cost of construction is much less than by the common method. Both the outside and inside being parallel, the expense of patterns and core boxes is greatly reduced, and in finishing less metal is cut away.

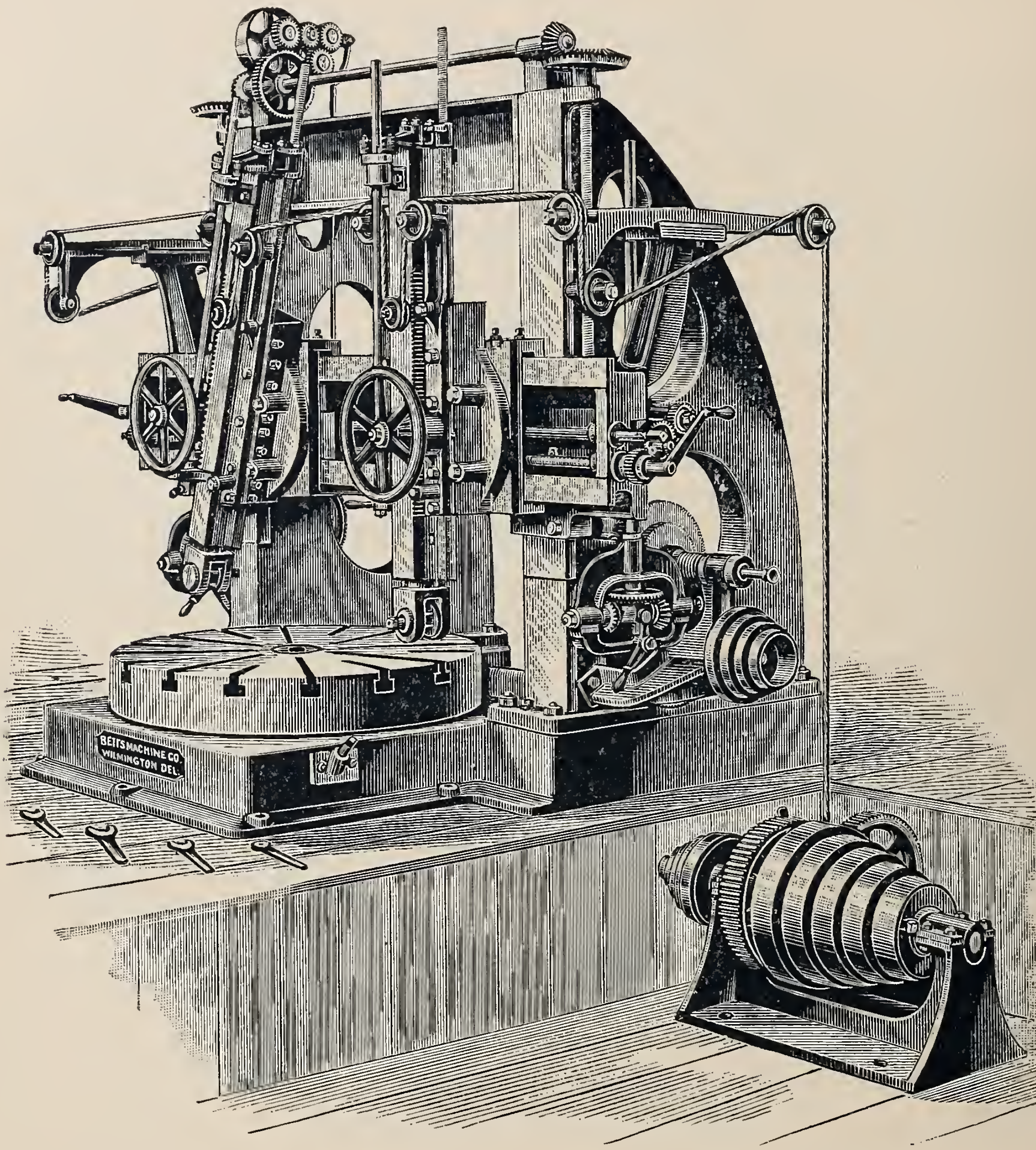


FIG. 1. STANDARD MACHINE.

HORIZONTAL BORING AND TURNING MACHINE.

THE BETTS MACHINE CO., WILMINGTON, DELAWARE.

Above, and on the opposite page, are shown perspective views of two designs of boring and turning machines, by the Betts Machine Co., of Wilmington, Delaware, who make a specialty of these useful implements to receive work from five to twenty feet in diameter, constructing them in the best possible manner, and have introduced a feature of much importance to the smaller class of shops, by arranging the standards to slide back on the main sole frame, so a ten-foot machine can be arranged to turn sixteen feet in diameter,

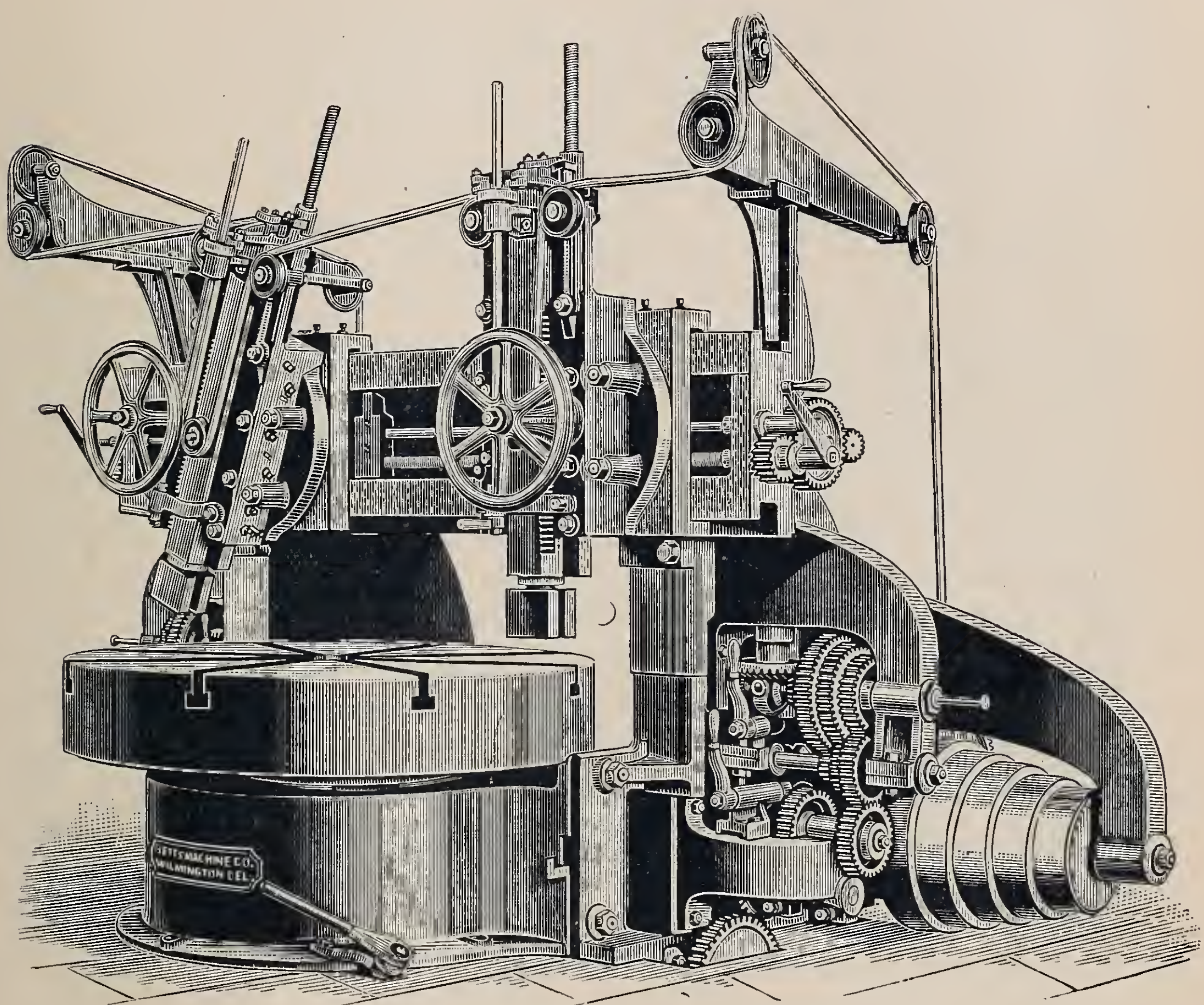


FIG. 2. MODIFIED MACHINE.

or a fourteen-foot machine to turn twenty feet in diameter. This is to meet special requirements, and save the expense of large machine-tools that would be necessary only in emergencies. It is a case where the combination idea can be carried out so as to do good work, and without risk of injury by over strain.

A number of these machines are in use on this coast, made by the Betts Machine Company, and we will not trouble our readers with technical description of them. Nearly all details are shown in the excellent drawings, and as to workmanship, the reputation of the company is a warrant of that. Some comments on the machines, as a class, will be of more interest to our readers, than explanation of what they well understand.

The functions and uses of these machines in a works are not so well understood as should be in this country, where they may be said to have originated. Their first use, so far as known, was by the celebrated John G. Bodmer, a Swiss engineer of Manchester, England, who 45 years ago made wonderful improvements in various kinds of machine tools, and among other things produced what he called "verticle lathes," nearly the same as the American "boring mills" as they are now commonly called.

For some reason, hard to understand, the English people failed to comprehend their merits. Their "evolution" was transferred to this country, and centered in and around Cincinnati, Ohio, where they completely supplanted large lathes for all kinds of face work, turning and boring on pieces of large size. The machines made were characteristic of practice at that day, light and simple, but eastern makers, especially the Betts Company, soon after took the matter up and made them of a higher class with added strength, adjustments and good fitting. Their place and capacities in a machine works are hard to describe. For all kinds of rotary work except upon shafts, they are far superior to lathes in respect to convenience, speed and quality of their performance. The horizontal plate enables work to be set, centered and held with ease and accuracy; the space occupied is the least possible, and the maintenance of the running joints is easy and complete. A more extended use of these machines is sure to come about in the future.

THE NICARAGUA CANAL.

CORPORATE CONSTRUCTION AND OWNERSHIP AGAINST THE POLICY AND BUSINESS INTERESTS OF THE UNITED STATES.

BY N. J. MANSON.

[Communicated.]

On the 2nd day of June, 1892, the writer caused to be personally delivered to Captain Merry, and to each and every member of the Nicaragua Canal Convention held at St. Louis, on that date, a pamphlet of nearly thirty pages, entitled "The Nicaragua Canal; Government Construction and Control a Necessity; Corporation Construction and Control Against the Policy and Business Interests of the United States."

From that date, the 2nd of June, until the 1st of September, 1892, no publication has appeared, to the knowledge of the writer, in any way controverting the statement of facts, and of the principles of government and of law which were collected and set forth in that paper, and which it is believed control the enterprise of a ship canal at Nicaragua.

Within the past few days my attention has been called to an article, by Captain Wm. L. Merry, in that very excellent publication, INDUSTRY, perhaps intended as a reply to at least a portion of that pamphlet, which had, in the month of August, been republished in INDUSTRY.

As Captain Merry largely represents, on this Coast, the Maritime Canal Company, of Nicaragua, and, perhaps, the Nicaragua Canal Construction Company also, and as he is a stockholder in one, or both, of these corporations, his utterances are entitled, at least, to careful perusal, and if it be necessary to answer them, accuracy and candor should markedly characterize the reply.

Capt. Merry states in his publication of September 1st, "That while I do not differ from Mr. Manson as to the necessity of Government control, I must decline to accept, as facts, some of his assertions in connection therewith."

This is an incorrect statement of Mr. Manson's position, and is the mere statement of the corporation and its friends. No friend of the people of the United States, or their Government, has ever urged the necessity of Government *control* in the sense in which Captain Merry has all along used that term. If by Government control is meant Government construction, possession, management and ownership, there is no discussion between myself and any friend of the incorporation. But if by Government control is meant, as set out in the paper of June 2nd, page 25, after a careful, and I submit candid, review of the law and facts, "The anticipated function of the United States under corporation management of the Canal is to furnish the financial credit, guard the Canal, guarantee its neutrality, and aid the corporation in collecting its tribute." Or again, on page 26, "The attitude of the Nicaragua Canal Company toward the enterprise of a ship canal at Nicaragua is to seize upon a work planned, staked out and cherished by the Nation, to have the Nation furnish the credit for the enterprise, to expect it to aid the corporation in sapping the industries of its own people, to aid the corporation, if need be, with guns, men and fortifications, in collecting its high exactions on commerce, and as a consequence, to have this Nation take the risk of engaging in unjust foreign wars." For the Government after creating the credit to stand by and see that the corporation does collect the tolls out of the business and commerce of the people of the United States. If that be what is meant by Government *control;* and which the paper referred to demonstrates is meant by it, then there is a line of difference between Captain Merry and myself which is not very likely to be removed. He should not have contented himself with a general denial, he owed it to himself and to the country, to state the facts if they differed materially, or at all from what the writer stated them to be. To the important facts that under Government improvement and control of the Great Lakes and of the Mississippi River system, wonderful development and an era of unexampled prosperity has dawned upon all the vast sections tributary to those highways, thus kept open and improved by the Government, without charge or toll of any kind, and to the fair inference that like results, (though greater), would attend and follow like improvements at Nicaragua, no answer is made.

But the corporation, speaking through its friends, makes the withdrawal of the Zavalla-Frelinghuysen treaty, the pretext for occupation of the Nicaragua route. At a time when secrecy was deemed necessary by Secretary Frelinghuysen in the negotiation of this treaty, the secrecy of the Senate was violated and the treaty itself given to the world. For this disclosure suspicion attaches to the schemers for corporate control of this great National enterprise. Much that by well directed diplomatic effort might have been gained for the Nation was for the time lost, and the new Secretary found himself confronted with a treaty undoubtedly objectionable in some of its features, and which did not assure to the United States the advantages to which they were justly entitled, because of this and other entanglements, and since diplomatic effort could secure at that time nothing additional, the treaty having been published broadcast to the world in violation of the then rules of the Senate, and in the interests of schemers for private control of the Canal, it was withdrawn.

Does any one believe that the present corporation is justified in thrusting itself between the Government of the United States and this great work because, *from any reason*, it became necessary to withdraw the Zavalla-Frelinghuysen treaty? It is the nature of all free and representative governments to move slowly. Schemes rush in where fredom is slow to tread. A measure must be thoroughly understood by the people, whom it is intended to benefit, before it can be expected to receive from their representatives and officers that attention which will secure its passage. The Canal Company, for their own private emolument, are doing all in their power not only to defeat the great right and interest which the United States has in this enterprise, but they seek to commit the United States to a policy which expressly recognizes in the private stockholders, and in the foreign states, Nicaragua and Costa Rica, the right to fix the tolls on the business of the one practicable route which is to unite the oceans embracing our country.

Captain Merry denies that the Nicaragua Canal Construction Company compares with the Credit Mobilier, and attempts to prove it. One fact is worth a ship-load of argument in these matters. But let us look at the argument. Mr. Hitchcock, the president of the Maritime Canal Company of Nicaragua, stated under oath, and in answer to a direct question, that all the stockholders of the Maritime Company are members of the Construction Company.

The writer pointed out in his paper of June 2nd, that the proposed bill recognized in terms the existence and organization of the Nicaragua Canal Construction Company, an organization which he stated might have the same relation to the Maritime Company which the Credit Mobilier, Contract and Finance, Western Development and Pacific Improvement companies have to certain railroads. He also pointed out that the Company might in a similar way let contracts to itself, at any figure, and not according to the *value* of the work, as stated by Captain Merry, but for what the Construction Company got the contract at. "Cost" is the word used in the bill, not "value."

It is not pretended that in all respects the Nicaragua Canal Construction Company is the same as the Credit Mobilier, or Contract and Finance Company, etc. It is to be hoped that thus early in the transactions, before one cent of subsidy has been granted the Canal Company, that the Construction Company has not formed itself into a Credit Mobilier arrangement, but is, in point of fact, a most exemplary organization. The apprehension, however, is not entirely baseless. I trust, that should they ever get the subsidy (which the people forbid!) they would in no slight degree resemble the Credit Mobilier. Perhaps Congress is possessed with some such apprehension, or it might long ago have granted the subsidy.

Captain Merry says "the guaranteed bonds are not issued," "except as work has been executed, and for its actual value, as stated by a board of U. S. Engineers appointed by the President." Captain Merry mistakes the bill, doubtless unintentionally; the word is *cost*, not *value*. The idea being that the Maritime Canal

Company may let a contract to itself, the Construction Company, at any figure, and then to show to the board of Engineers that it ''cost'' the Maritime Canal Company that amount, because they let the contract to the Construction Company at that figure, and no matter how honest and incorruptible the Board of Engineers, they would have no pretext for looking into the value of the work which the company is letting to itself; for the bill itself tells the Engineers they are to concern themselves only with the *cost*, and upon their certificate that the work has been executed at its '' cost, (not actual value), this corporation goes into the treasury of the United States for the guaranteed bonds. This is a ''careful, conservative and well considered measure!'' (for the managers).

How much does any one imagine the Nicaragua Canal would cost upon this method of doing business? And how much would the tolls be placed at if they are to be levied on the cost of the Canal, and they are not to exceed annually fifteen per cent. on the '' cost,'' excluding *all* charges for salaries, maintenance, administration, etc.

The Maritime Company would be doing such a fine business, drawing *costs* out of the treasury, that it might never complete the Canal. For if all its stockholders were not drawing dividends on construction its managers could be doing so, passing this subsidy, as fast as they can get it, into their other pocket, the Construction Company, and humbugging *now* the people of the United States by talking about *value* for *cost*.

The word value is not to be found in the bill in connection with any work to be done. The word is *cost*. This is truly a '' 'careful,' 'conservative' and well considered measure.' '' The Construction Company, under this bill, could eclipse the Credit Mobilier so far that the latter would be astonished at the limit of its robberies.

Captain Merry says '' actual value.'' There is no actual about it. The purposes of the bill might by possibility be defeated by using even the expression '' actual cost. The word is plain and unadorned, it is *cost*.

I desire to call the attention of friends of the corporation, to the following '' Declaration of principles,'' reported by a select committee of the House, composed of the most eminent men in the Nation. This unanimous resolution of the committee declares as follows: (The italics are by the writer).

''§ 1. Resolved by the Senate and House of Representatives of the United States, in Congress assembled, that the establishment of any form of protectorate by any one of the powers of Europe, over any of the independent states of this country, or the introduction from any quarter of a scheme or policy which would carry with it a right to any European power to interfere with their concerns or to control, in any manner their destiny, etc., is a measure which this Government has, in the declaration of President Munroe, in his message of Dec. 22nd, 1823, and known as the Munroe Doctrine, avowed its opposition, and should the attempt be made it will be regarded and treated as dangerous to our peace and prosperity."

"§ 2. That it is the *interest* and *right* of the United States to have the possession, direction, control and government of any canal, railroad, or other artificial communication, to be constructed across the Isthmus, connecting the American continents for the transfer of vessels and cargoes from the Caribbean Sea to the Pacific Ocean ; whether the same be constructed at Panama, *Nicaragua* or elsewhere, and, in view of the magnitude of this interest, it is the duty of the United States to insist that, if built, and by whomsoever the same may be commenced, prosecuted or completed, and whatsoever the nationality of its corporators, or the source of their capital, that the interest of the United States and their right to *possess* and control the said canal, or other artificial route of communication, will be asserted and maintained whenever in their opinion it shall become necessary."—*House Report 390, 46th Cong. 3rd Session, pages 9 etc.*

In Section 3 these resolutions are declared to be a "Declaration of Principles."

President Hayes was equally clear in stating the relation that any enterprise connecting the oceans, embracing our country, bears to the United States. In his message to Congress, in Dec. 1880, he says :

"The views which I expressed in a special message to Congress in March last, in relation to this project, I deem it my duty to again press upon your attention, subsequent consideration has but confirmed the opinion that it is the right and duty of the United States to assert and maintain such supervision and authority over any interoceanic canal across the Isthmus that connects North and South America, as will protect our national interests."

Shall the Government of the United States recognize in the States of Nicaragua and Costa Rica and a few private corporators, the right to fix the tolls on this canal? Shall the Government of the United States after guaranteeing the entire bonded indebtedness of this incorporation, and though holding seven tenths of the stock, recognize in the corporation the right to fix the tolls? Shall it be represented by a minority of the directors? Shall the bill be utterly silent on the power of Congress to reduce the tolls to a fair and reasonable amount ; or is the corporation, in this vital matter, to be a law unto itself? Is this the policy to which the United States is to be reduced by its public-spirited and patriotic citizens? Do the great, cardinal and sacred principles of this Government change with the seasons, and at the bidding of a crafty and designing corporation?

Is that corporation at one moment to solicit private capital, at another to procure the draft of a bill, creating a credit, and entirely ignoring and granting away the most sacred rights of the people and their government; and, at the next moment, threaten the people of the United States, that they will sell out to foreign governments and foreign capital unless this Government, or its private citizens, accede to their demands?

Who are the originators of this bill, the main provisions of which were outlined in the paper of Jan. 2nd., on pages 7 and 8, and to which Captain Merry does not deign to reply, except to admit the bill may be amended? The charge is often made and seldom denied that the Senate of the United States is the theater for personal aggrandizement. While it contains good men, a large number are selfish and unscrupulous, but the real author of the bill is not the Senate of the United States.

The father of this bill "Is that legal entity endowed with more privileges and powers, and fewer responsibilities than belong to common men. This artificial power is stronger than Samson and Hercules combined. It is more tyrannical than King George, and less merciful than chattel slavery. A monster, powerful, aggressive and grasping, which today dominates society, politics, industry and commerce. Political parties tremble in its presence. Party leaders do its bidding. Finance, transportation, and all industry fatten it with billions in tribute." This creation has jumped the claim of a nation of freemen, staked out in the interest of liberty, the key to their peace and prosperity. By wily methods it has gained possession at Nicaragua, and, in a multitude of forms, sends its representatives into the National Congress, corrupting and poisoning the very sources of power; and, along with others of its ilk, making justice between man and man and corporate power unusual, if not impossible.

It is without patriotism, and has no regard for the principles of Government; without conscience it cannot suffer the pangs of remorse; without feeling it cannot be punished as its crimes deserve. Soulless it fears not eternal damnation. It speaks through its friends, and they tell us that if the United States do not come to their terms they will sell out to foreign countries and foreign capital, whatever declarations of principles, sacred to our people, may declare. When a bill, clearly despicable, is held up to public execration, again the voice of its friends is heard. "The Canal Company is not attempting to influence pending legislation in Congress, as Congress itself has declared through its Committee in the Senate."

Once again we hear the voice of its friends: "The control by the bill is practically given to the United States on its own terms." If this is the case why does the bill give a minority of the directors to the United States, though the United States is the country affected by the enterprise, guarantees the whole bonded indebtedness, and holds seven tenths of the stock? If the control is given to the United States on its own terms, why does not the bill itself fix the tolls? The bill must itself specifically fix the rates of toll with the full power recognized in the Government to make a fair and proper reduction whenever, in the opinion of a majority of the people of the United States, it shall become necessary. But for the allegations of its friends, that the control is offered to the United States on practically its own terms, I have an answer still more laconic—it is not true.

The corporation cannot, *under the concessions*, offer any real control to the Government of the United States. Articles VIII and LIII, of the Nicaragua concession, expressly declare that neither the concessions, nor any land conveyed by them, shall be transferred to any foreign Government, and the concessions themselves are, in express terms, declared forfeited by such transfer. By Articles X and XI, of the same concessions, the majority of the directors is fixed in the foreign states of Nicaragua and Costa Rica, and the private stockholders. Clearly then the corporation has no real control to offer the United States, and it never was intended that it should have any.

No private citizens, however worthy, should be allowed to own and operate this Canal for a profit. But private capital is not really seeking the investment. Private *enterprise* is seeking to induce the Government to make this investment, and then to have the Government abandon its principles, and permit these enterprising citizens to control the fruits and results of the investment.

Once again the voice of its friends is heard, "The appropriation by the private corporation of the extensive surveys made by the Government is admitted, but it involves nothing objectionable," and this startling statement is fortified by the avowal that they have even the Government's Chief Engineer of the Canal.

Speaking for myself I frankly confess that I would prefer for neither the corporation, or its friends, to be the judges of their own acts, certainly in this regard.

It would be, at least, desirable to hear something from disinterested parties, as to whether this appropriation was objectionable or not.

The circumstances are all important in determining that vital question which is so promptly and flippantly decided. "The appropriation of the extensive surveys of the Government involves nothing objectionable." Is the appropriation of the one practicable water route uniting oceans and our coasts, nothing objectionable?

Again they tell us, that in this Canal, we are dealing with a foreign government, none the less jealous of its sovereignty because weak in a military point of view. Have they nothing to say for their own country, the United States? Is not the United States a country jealous of the real welfare of its citizens? Does Nicaragua build this Canal for itself? Is its mercantile marine so strong and numerous that it must build this Canal to tax the industries of its people who intend using it? Or, rather, is not the truth quite different, that Nicaragua is a mere figure head in this transaction, being used by schemers to put upon the people of the United States a tax on all the interchanges of commerce between the two shores of our country and the world?

It is now pretty generally conceded that the construction of the Suez Canal, by private capital, was a mistake in the governments which permitted it. Shall free America do here what monarchical Europe now deprecates there? Mr. Jeans, the very learned author of Water-ways and Water Transports, is today probably the highest authority on freights and fares in the world. On page 268 of his valuable work, after some discussion as to the maritime powers of Europe, making arrangements to acquire the Suez Canal, and throwing it open to the commerce of the world. "This proposal" says he, "is one that is entitled to every consideration."

Again, on page 472, "The state should take care, by enactment or acquisition, that the country does not lose the immense economical advantages that accrue from the cheapness of water transport."

I cannot leave this portion of my observations without saying to the railroad interests of the United States that they have nothing to fear from the construction of the Nicaragua Canal. "Each of these two ways of communication has its distinct and separate domain."
—*Water-ways and Water Transport*, page 441.

"Far from being enemies, railways and canals aid one another in the performance of their natural duties. The former transport passengers, costly merchandise, manufactured products, all that cannot endure long delay. The latter, on the other hand, transport raw materials of small value, for the transportation of which speed is of secondary importance, which cannot bear high rates of charge, and which in consequence do not form a remunerative traffic for railways."—M. Picard, in *Les Chemins de fer de France*, 1884.

Captain Merry concludes his article on the Canal, with the assertion that those who do not approve of corporation ownership of the Nicaragua Canal, are obstructionists, "because the conditions are not as favorable as could be wished." The object of this paper is to point out the real obstructionists. They are those who have thrust themselves in and stand between the natural guardian and custodian of this great enterprise and the work itself

The charter of the Maritime Canal Company of Nicaragua should be cancelled and repealed under Section 8 of the Act of February 20th, 1889, incorporating the Maritime Canal Company of Nicaragua, which reserves to the Government the power of repeal, as the first step to the prompt and effective action of the Government itself.

When constructed and opened by the Government of the United States, its people can point with a pride, just and well-founded, to a system of improvements working together as one connected and harmonious whole, the legitimate product of free government and free thought, placing their Government and themselves first among nations. I mean a system of improvements partly internal, and yet as comprehensive as the world — the Great Lakes, the Mississippi River system, the Gulf of Mexico, two oceans indissolubly joined ; all working together freely and uninterruptedly, in the interest of commerce and of civilization. Neither the prey of the other, yet each supplementing the other and acknowledging it as the fountain and source of its life and commerce.

I know of but one way to make a nation great and truly prosperous, its people contented and patriotic, to produce in this country not the form but the real spirit of union. Indifference to, or reckless disregard, of the most sacred rights of a people will never make a nation of patriots, patriotism and protection are reciprocal. This is the road that all great nations have trod. The rights of the people of America to the construction and ownership of the Nicaragua Canal can never be assigned to any incorporation, no matter what the nationality of its corporators, or the source of their capital may be, much less can the nation furnish the credit for such a scheme. Their commerce, little though it be, redeemed and restored as it would be by Governmental construction and ownership of the Nicaragua Canal, can never be made the prey of corporate greed. The ship canal at Nicaragua must enure to the prosperity and welfare of the whole Nation, and not to the favored few. That it is the gate to prosperity, no one who has considered the question will deny. The incorporation has possession. The charter of the Maritime Canal Company of Nicaragua should be repealed.

San Francisco, Sept. 22, 1892.

THE ENERGY OF HEAT.

The following extract from an article, by Mr. F. J. Roth, in the *Stationary Engineer*, describes the apparatus employed by Joule in his celebrated experiments on heat.

"The best known of Joule's experiments was that in which a brass paddle consisting of eight arms of complicated form arranged symmetrically round an axis was made to rotate in a cylindrical vessel of water containing four fixed vanes, which allowed the passage of the arms of the paddle but prevented the water from rotating as a whole. The paddle was driven by weights connected with it by strings which passed over anti-friction rollers, and the temperature of the water was observed by thermometers which indicated $\frac{1}{200}$ of a degree Fahr. Special experiments were made to determine the work done against resistance outside the vessel of water, which amounted to about .006 of the whole, and corrections were made for the loss of heat by radiation, the buoyancy of the air affecting the descending weights, and the energy dissipated when the weight struck the floor with a finite velocity. From these experiments Joule obtained 772.692 foot pounds in the latitude of Manchester as equivalent to the amount of heat required to raise one pound of water through one degree Fahr. from the freezing point. In various other experiments Joule obtained results varying from 772 to 776 foot pounds. In some of the experiments great noise was produced, corresponding to a loss of energy, and Joule endeavored to determine the amount of energy necessary to produce an equal amount of sound from a string of a violincello, and to apply a corresponding correction. The close agreement between the results of experiments, differing widely as they do in their details, at least indicates that 'the amount of heat produced by friction is proportional to the work done, and independent of the nature of the rubbing surfaces.'

SAN FRANCISCO ROCK FISH.

The adleheaded rock fish, (*vulgaris*, *rock cod*,) of San Francisco Bay, is in a fair way to extinguish himself. His rapacity for food, of any kind, makes him the prey of the skilled and unskilled alike. All he requires, in order to be hooked, is some kind of edible substance as bait. Anything will do, shrimps, clams, worms, fresh or salt fish, all comes alike, and when other feed is wanting he sets out to devour his own tribe. The amount of these fish, caught with hooks and carried away from Sausalito in the Summer months, must exceed a ton each week. They are prolific, however, and have no successful enemies among the small fry, but are the constant prey of dog fish, also the sea lion, under some circumstances. They are "bottom feeders" living mainly on *molusca* and *crustacea* found on and about rocks washed by strong currents, but between tides it is not unusual for even the larger ones to follow up the sides of submerged rocks in search of food, until they come near the surface. This is the opportunity of the wily seal, or sea lion. He crawls in and out about the rocks, and any stupid rock fish there is an easy victim. The habitat of the rock fish is, as his vulgar name indicates, about the rocks, or stones rather, because his favorite resort is a rough bed of stones, washed by a strong current, and where there are interstices in which to lie, without effort, while the tide is running. When slack water comes they start out to forage, and as before remarked, will devour anything that comes to hand. Fishing tackle that would fail to capture almost any other kind of fish is all right for the stupid rock fish. The lines may be glaring white, and a sinker in motion has no terror for him, all required is some edible substance in view.

The size of the fish is tolerably well graded to the depth of the water, in the outer bay, at least, and favorite fishing is 100 to 150 feet of water, where the time and labor of raising lines is not too irksome. In 100 feet of water the change of pressure equal to 43 pounds per inch stuns the fish, while at 150 to 200 feet he comes to the surface in comatose state. In five minutes or so, when an equilibrium of pressure comes about, in his tissues, he sets up a frightful struggle, and evinces a vitality and activity no one would expect after "pulling him up." These remarks are by a fisherman, and are expected to cause some astonishment on the *Albatross* when compared with the U. S. Fish Commission's scientific data.

ENGINES OF THE BATTLE-SHIP "OREGON."

In our last issue we commented upon the "voluminous" outfit of a modern war vessel, and since then applied to Mr. George W. Dickie, manager of the Union Iron Works in this City, for particulars respecting the number of steam engines on the battle-ship *Oregon*. Mr. Dickie has sent the following list, set down from memory, which is here arranged in tabular form.

Number of Engine Cylinders.	Purpose of Engines.	Characters of Engines.	Diameter of Cylinders in inches.			Stroke in Inches.
6	Main Driving, 9,000 H. P.	Triple	34½″	48″	75″	42″
4	For Air Pumps	Double	6″			12″
4	For Circulating Pumps	Compound	7″	12″		6″
2	Hot Well Pump Engines	Single	8″			16″
2	Fire and Bilge-Pump Engines	Single	10″			16″
2	Air and Circulating Pumps	Single	10″			16″
4	Ventilating Fans	Compound	5″	9″		6″
4	Barring Engines	Double	6″			6″
2	Reversing Engines	Single	14″			18″
4	Hydraulic Steering Gears	Double	8″			12″
4	Main Feed Pumps	Single	12″			16″
4	Auxillary Feed Pumps	Single	10″			16″
8	Ash Hoisting	Single	5″			6″
16	Fire-Room Fans	Compound	5″	9″		6″
4	Steam Cranes	Double	8″			10″
12	Hydraulic Pumping	Single	20″			30″
8	Steam Winches	Double	8″			10″
2	Windlass Engines	Double	16″			12″
8	Dynamo Engines	Compound	7″	12″		6″
2	Ice Machines	Double	12″			16″
8	Ventilation	Compound	5″	9″		6″
1	Distilling Room, Air	Single	10″			12″
1	Water and Brine	Single	6″			10″

Besides this list, making one hundred and twelve engines, counting each steam cylinder, there are some connected with the torpedo service, the dimensions of which are not yet determined. After looking over this list one will conclude that the steam machinery of a modern war ship is the principal part. She is indeed a great magazine of machinery, much of it of a delicate nature, and all requiring intelligent care.

TORPEDO ETHICS.

The waste of human effort in the invention and preparation of means for destroying life and property is the crowning anomaly of our age. For twenty years past the various "powers," some of them too poor to pay debts incurred for the necessary expenses of government, have been busily engaged in making or acquiring torpedo apparatus—a sneaking, cowardly method of warfare, in which the attacking party incurs no danger and the attacked has no means of defense — corresponding to the bomb practice of the anarchist, which is classed among the worst of human crimes.

Between torpedo boats, torpedo outfits for war vessels and the automobile contrivances to be sent from shore, the money spent on this torpedo craze amounts to hundreds of millions of dollars. It has become a distinct branch of warfare, requiring special training and a department the most expensive of all in the war establishment of countries. The total result of all this has been the destruction, after various futile attempts, of a single vessel, the *Blanca Encalada* in the harbor of Valparaiso.

It is hard to reconcile such things with anything but savagery. The substance of the people required for bread, means of shelter and education, is wrested from them, by force of arms in some cases, to be used in the production or purchase of torpedoes and other means of destruction. The highest mechanical and engineering skill, that would if concentrated on useful purposes change the whole industrial world, is squandered on war and war material without even the poor excuse of success.

To show how far this torpedo branch of warfare is likely to be permanent, we will quote from the London *Engineer* of June 10th last, a conservative journal, careful in its utterances. The extract is from an article, on "Pneumatic Dynamite Guns."

"A weapon which is likely to supersede any of the motive or stationary torpedoes that have hitherto been introduced for coast defence, is now in process of erection by the British War Department at Dale Point, in Milford Haven. That is to say, it will supersede them if the influence of vested interests in other inventions, to which the Government feels itself financially pledged, can be overcome. The weapon is the 'Aërial Torpedo Thrower,' or pneumatic dynamite gun, which has been purchased by our military authorities from the Government of Victoria in Australia, having been manufactured by the West Point Foundry, at Cold Spring-on-Hudson, in the United States. The most remarkable feature connected with the introduction of this weapon into the armament of our coast-line defences has been the entire absence of all notoriety in the transaction. So phenomenal was its power of accuracy at long ranges when tried at Shoeburyness in January and February of last year, that the heads of artillery, engineer, and other departments, were absolutely petrified with its success. Yet, singular to say, no detailed accounts were promulgated in any of the newspapers or periodicals of the United Kingdom as to the result of the experiments until long afterwards, and then only in a meagre form, whilst the first useful description of the perfected invention appeared in the *New York Engineering Magazine* for September, 1891."

Since 1887, experiments have been going on in this country with these dynamite guns. The *Vesuvius*, a government vessel, built at Philadelphia, was to accommodate dynamite pneumatic guns of fifteen inches bore that, according to reports, failed in accuracy of range and otherwise, but we are now doomed, no doubt, to undergo a period of dynamite guns in which there will be a new round of experiments, National emulation, civic honors bestowed on inventors, and the rest of it.

If there is justifiable revolution and revolt of the common people, it will be in their riddance of this kind of wrong and waste. The pretense of avoiding war by such means, sometimes put forward, is a pitiful humbug, good enough perhaps for people who will give their means to be applied to such purposes, but it would be an axiom to say that a tenth part of the same effort spent in producing amity and trade among nations would build up better and more permanent safeguard against war and render torpedoes and dynamite guns useless.

Such ideas as these are commonly relegated to the field of utopian philosophy, and in view of the present spirit abroad in the world, such a charge has some reason, but it must be admitted there is unrest on all sides that gives no promise of ceasing, on the contrary is increasing, and in the end must find a remedy of some kind. Such remedy is not in view ; we have all kinds of people, wise and otherwise, predicting, explaining and philosophising over the problem of what is the cause and what the remedy for this growing discontent which in various forms, from organized protest to anarchy, is found in all countries.

Our answer is : Armies, navies, guns, torpedoes, dynamite and destructive agents consuming the substance of the people, estranging nation from nation, and exciting so much of savagery as yet unfortunately remains in our human composition.

The army and navy themselves are a sequence, not a cause, or responsible, except in small degree. It is the political elements that foment and cause war—people who keep safely away from its consequences; those patriotic people who want "some one else," to go out into the world and smash people for "glory."

ITALIAN ARMAMENT.

Premier Crispi, in the *North American Review*, July, undertakes to explain and excuse why his country has been taxed and enervated by draughts for war vessels, war material and men, and makes out a case which is perhaps satisfactory to himself and the "jingo" spirit of our time.

He shows how Italy can mobilize 1,200,000 men, and says this is one fifth as many as his immediate neighbors, or the "three powers on the frontier," can bring against him, and leaves an inference for most sensible people that the military arm is no more than an important adjunct and appendage of the crown, and a nursery of those classes who consider it a disgrace to be useful.

Those countries that have no armament to speak of, Belgium and Holland for example, are the safest in Europe from attack by other "Powers." We hear nothing of their being despoiled, and will not. Holland should be an entrépot for Germany, and geographically is an integral portion of that military empire, but Germany does not dare to molest Holland. Switzerland, Sweden, and Denmark are safe enough, because of their not being military powers, and depending upon the honesty and sense of justice in the greater countries around them.

Denmark, a quarter of a century ago, indulged in the show of an army and a military establishment to comport with the dignity of a monarchy, and a history of two thousand years of national life. To show her prowess she got into a war with Prussia and lost the Schleswig-Holstein Peninsula. Had Denmark been without an army beyond what was required to maintain peace among her own people in emergencies, other great powers would not have permitted Germany to annex the Danish provinces. England, as it was, came near interfering, but the Danish army presented a reasonable excuse for not doing so.

The Kingdom of Italy has made amazing progress, as all must admit, but would have made much more and would, no doubt, be safer from conquest if there were no great armament, such as she aspires to.

INTERNATIONAL PATENT TREATY.

We have several times questioned the operation of the rules of treaty adopted at what is called the International Patent Convention of 1883, when the provisions then adopted would, in any way, conflict with various statutes of various countries involved. Such a difficulty has arisen in France, which, of all countries concerned in the convention, was least likely to have pleaded their prior statutes, because of the wide discretion permitted to judges and courts in that country.

The decision of the *Cours de Paris*, on an appeal, in a recent case contained one ruling of much importance, which was that the provision for manufacture in France, within two years from the date of a patent, was satisfied by the inventor having executed "a license to a French firm to manufacture," and they had "supplied" the article to meet demands within the period of two years. The patent was sustained in the court above named.

This International Patent Convention is not very well understood. The following is the gist of the provisions agreed to:

1. "Six months priority of right are given to apply for a patent, and three months priority of right to apply for protection of industrial designs and models, and trade and commercial marks. An additional month is allowed for countries beyond the sea.

Under this article, any person having applied for a patent, or for registration of a design or trade mark, in one of the contracting States, can obtain protection in any of the other contracting States by application there within the times specified, notwithstanding that, in the interval, acts may have been done which would have defeated the purpose of the application — such, for instance, as the use or publication of an invention, or an application for a patent by a person other than the inventor.

2. Importation is allowed of objects manufactured in any of the States of the Union without entailing forfeiture of patent or other rights.

Formerly a patentee could not, without forfeiture of his patent, introduce into some of the States of the Union the patented articles manufactured in his country or elsewhere. A patentee, while now free to import into any of the States, must, nevertheless, comply with the laws of that State with regard to the working of his invention within prescribed periods."

LITERATURE.

Dynamometers and the Measurement of Power.

BY PROF. JOHN J. FLATHER.

This treatise deals with the various devices and apparatus that have been employed for the measurement of power, including the latest as well as the early methods, and states in mathematical terms the principles involved in the various dynamometers, and includes diagrams of the same.

The book is opportune, because just at this time, the subject of measuring, indicating and recording power is being considered in several countries, especially in Germany, and the near future will no doubt, bring forth indicating and recording devices commercially practicable, or as we may say commercially indispensable.

The elements dealt with, are intensity and time, or, force and space, so that recording apparatus of all kinds must consist of two parts to perform two functions, the relations between which, are, a measure of the force passing through a machine at any particular moment, and the sum of work performed over a given period.

It is to be regretted that Professor Flather could not have included in his book the experimental work of Mr. H. C. Behr, of this City, who, we have no fear in asserting, has given more study to this subject than any other engineer of our day, and who has been for some years past engaged in experiments that are attracting attention in Europe as well as in this country. The late fire in this City, when the Fulton Iron Works were burned, destroyed a recording dynamometer constructed from Mr. Behr's designs, that was certainly an advance upon the *Totaliseur* of Morin and Poncelot of 1857. Mr. Behr, who is one of our most eminent constructing engineers, proceeds upon strictly scientific premises, and his friends are watching with much interest the result of his efforts.

Professor Flather modestly confines his interesting treatise to facts, and the present edition, the only work of the kind, is no doubt the forerunner of another one that will not long be delayed. The work is fully illustrated, well written, and is published by Messrs. John Wiley & Sons, New York, Price, $2.00.

Cassier's Magazine, No. 9.

JULY, 1892.

This number begins with a very complete account of the Newport News Ship Building and Dry Dock Company's works, containing a large number of plates showing the general and also the special construction of this important plant.

It was not easy at the beginning to see what the plans were on which such an extensive scheme in ship building was based. The navigation laws and general policy respecting the deep sea marine, has since 1860, come near driving our foreign trade off the seas, and this Newport News scheme of Mr. Huntington, as everyone supposed, indicated a belief, on his part at least, that there would be some relaxation of the stringent regulations that hamper our shipping. Such a view has in some measure been verified, and there is no doubt that under a more liberal policy the great shipyard will not only find business in the coast trade, but also for the high seas.

The implements, many of which are illustrated, are all of a high class. A traveling crane reaching each way from a trestle-way spans two building slips, so the material is all handled by power, the same as at the Union Iron Works here, but less conveniently.

One plate inscribed as a "boiler shop" is a machine fitting department, and none of the plate working machines, except one for scarfing, are shown.

The dry dock is 600 feet long on top by 130 feet wide, with a draught of 25 feet. It can be emptied in one and a half hours. The most astonishing thing of all stated is that Newport News, the terminus of the Chesapeake and Ohio Railway, exported in February last, $2,038,376 worth of goods, and within one fifth as much as Philadelphia. For the year exports were about ten millions.

The Californian.

SEPTEMBER, 1892.

One setting down the title of serials usually refers to the name, date, and number, commonly to find the last named useless. To number a journal, magazine, or anything, as one of a volume, instead of serially from the first, is of little or no use as a reference. Volume makes a natural division, and what this lacks, number should supply. The two make a perfect reference, but as before said, a number in a volume is meaningless. It is a common expedient to create an impression of "age." One will find attenuated monthlies divided into two volumes a year, with only matter enough in several years to make one volume.

A glance at the number of a serial that is properly numbered shows at once its place in a series, but that is, perhaps, the thing to be concealed in some cases. The present is No. 11, of the *Californian*, and we regret it is not called so.

Mr. Charles G. Yale, known to all the "salts" and boatmen around the coast, the able editor of the *Mining and Scientific Press*, writes in the present number, of yachting around San Francisco. No one is better prepared to do so, and we only regret that the dignity of a magazine article has deprived us of the wit and humor that must have cost Mr. Yale quite an effort to sup press.

In writing on descriptive subjects, when there is a "margin for the ideal," and for what may be called genial humor, Mr. Yale has few if any equals. His knowledge of yachts is complete, although for some years past he has kept around shore and even has torn down his own boat house, it has been more from severe pressure on his time, and for a period, want of health, than any lack of interest. He is a genial member all around, with the entré everywhere in all acquatic sports. The editor of the *Californian* should consider the present article an introduction, and prevail on Mr. Yale to continue, with some account of "Lubber Sailing" and "Cock-pit Recollections."

Captain Merry writes of the financial aspect of the Nicaragua Canal—a very important branch of that subject at this time—writes understandingly and ably, but the nature and manner of presenting new enterprises in this country, is in a measure lost, because of a wide-spread distrust of the care and disbursement of the funds subscribed. It is at this time the crowning impediment to our material progress, and with a few years more of increasing bad faith on the part of those entrusted with other people's money.

No matter what the standing of the company, or the nature of their guarantees, they must expect to meet the general feeling of suspicion. The subtlety of financial schemes is such that the public are unable to understand them, and of late years the most successful plan has been to promise fabulous earnings—a fortune in a year, and depend on the credulous for patronage.

If one will consider the endowment schemes here they will understand what is meant. A short time ago the State published and disseminated among the people a treatise on these endowment associations, to show their nature and the absurdity of their pretended methods, also a history of them here. This did no good, or at least not much good. People go on much the same with a blind confidence in financial propositions, that to call absurd would be flattering them.

The Panama Canal discouraged people, but it must be remembered that its failure was written down from the first, and its promotion was of the "fireworks" order among an impulsive people. The Nicaragua canal is a very different kind of scheme.

Corrugated Furnaces.

THE CONTINENTAL IRON WORKS BROOKLYN, N. Y.

We have received from this company a very fine circular, relating to their manufacture of corrugated flues for furnaces. This method of construction can be no longer mentioned as an improvement. It is a settled principle of good practice that made its way as fast as the exigencies of a difficult manufacture would permit.

The added strength and elasticity gained by corrugations are obvious and are proved by the following formula adopted by the U. S. Government inspectors:

$$W = T \times \frac{1400 \text{ const.}}{D}$$

W, being pounds pressure per square inch, T, thickness of metal in inches, D, mean diameter. This for one example permits a pressure of 175 pounds per inch for a corrugated flue 40 inches diameter of metal ½ inch thick, the corrugations being six inches pitch and 1½ inches deep.

The Continental Iron Works are to be commended for taking up this difficult manufacture, and to be congratulated too on having founded a very successful business in the production of these flues or furnaces. We feel an especial interest in the matter because of always recommending a wider use of internally fired boilers for stationary purposes, especially on this Coast, where the economy of fuel is a foremost considertion.

The Company say in their circular :

"Internally-fired boilers are economical in first cost, being self-contained; that is they are independent of masonry setting, cast-iron fronts, buckstays, tie rods, etc., and are therefore capable of being readily moved from place to place with little expense.

Internally-fired boilers are economical in the consumption of coal, from the fact that there is no brick setting to absorb and radiate the heat, and the furnaces being surrounded by water, the heat of combustion is more fully utilized than is possible in externally-fired boilers."

The corrugated tubes or furnaces are welded at the seam and then shaped by powerful machinery. They are annealed, tested, and the slightest flaw or imperfection condemns the work.

The Vauclain System of Compound Locomotives.

BALDWIN WORKS, PHILADELPHIA.

This system consists essentially in setting and connecting the two cylinders parallel, with a single distributing valve of the piston type between, and connecting the two pistons to one cross-head.

There are wide chances that this form and arrangement will prevail as the fittest for compound locomotives, securing, as it does, the required expansion in two cylinders, with the least possible amount of added machinery, and the least possible interference with the common functions and operation of standard types of locomotives.

Such predictions are not always safe, but there is a kind of intuitive perception in such matters among the skilled, and we think there are a good many who will concede what we have claimed.

As remarked two months ago it is believed, that in so far as the steam distribution by means of the "between" valve, Mr. Byron Jackson of this City, anticipated the arrangement of the Vauclain engine, but this is not the main point of the system called by that name, it is in the mechanical arrangement and independent action on each side, and of cylinders compounded without much change of their connections and gearing.

The pamphlet published under the title at the head of the article, by the Baldwin Locomotive Works, gives a complete explanation of the Vauclain system.

The Technical Magazines.

In both the *Engineering* and *Cassier's Magazines* for September, one is struck by the economic trend of various essays, and it is a hopeful sign. Our industrial interests are so interwoven with national economic problems, that it is quite time that cognizance was taken by professional people of the character, powers, and acts of those to whom are entrusted the making of our laws.

Any successful solution of the great problems of our day, also any remedies applied, will not come from law makers. That much we may depend upon. Our civil service is drawn mainly from two sources, the legal profession, and the rich. The lawyer is always a man of "sides." His environment, education and ideal, is two sides. He is "for or against." Impartial views and disinterested acts are no part of his creed. Even in the Judiciary the same rule applies. There are two sides. The rich, besides lacking education and breadth of views, are by their position, not representative of community. They too are men of one side, representing a struggle for money. It is full time that those elected to legislative functions, were drawn more from the industrial and scientific classes, and such a feature is suggested by the economic trend of the best technical literature of our day.

The present numbers are worthy of extended notice, replete with matter of interest and importance, but the want of space prevents more than this mention for the present numbers.

Consular Reports, No. 149.

JUNE, 1892.

Consul Charles P. Williams, at Rouen, France, contributes a short article of much interest respecting steamboats, and describes the *Louvre*, a boat of 500 tons, 160 feet long, and 800 horse power, that runs between Paris and Nantes, by sea, canal and river, all of which are traversed in the route. This boat is driven by two screws set in the hull amidship forward of the engines and within the vessel's cross section, so nothing projects beyond the sides or bottom. The screws are placed in pipes or covers and the construction is one that if successful should command attention. The *Louvre* is driven at eleven miles an hour in the river, which is as fast as is desirable.

There are lengthy reports on plate glass manufacture in Bohemia, Austria, and Belgium, but not from England where it seems the makers refuse to furnish any information. The Lancashire and Yorkshire districts of England are peculiar in this respect. Manufacturing processes are carried on secretly so far as possible. This spirit arose when competition with the continent in various manufactures existed a hundred years ago.

There is nothing new in the report of a technical nature unless it be descriptions of the very complete machinery employed in Austria for grinding plate glass.

One of the reports in this section relates to canary birds and their culture in Germany. It is a regular industry in Hanover, and amounts to 1,000,000 marks each year. Two thirds of the birds reared are sent to this country, estimated at about 70,000 a year. A German importer in New York, who manages the whole business, has thirty people employed. He imports also about 5,000 red birds, 3,000 nonpareils, 2,000 indigo birds, and 500 mocking birds, also deals in sea lions from San Francisco.

The Technical Index.

This publication is a monthly list of subjects of interest and use, selected among the current writings on various subjects of a technical nature, giving the number of words, the authors name, and the price at which copies of the articles are furnished by the Technical Publishing Company of 53 Park Row, New York.

The scheme is not new but it is vastly improved. The idea of an exchange bureau of literature has for twenty years been growing all over the world, pursuing the inevitable evolution that everything useful must pass through, and the present publication represents it in its most advanced and completed state.

The articles are numbered consecutively and are based on a unit of cost, that is, a certain number of words is fifteen cents, and a larger number or a longer article is rated as two or more of these units, that is 30, 45, or 60 cents as the case may be. This permits the use of checks or tickets of fifteen cents value that can be paid for articles.

The future will no doubt bring forth a common use of this system, not only in the case of authors and writers but for the secular reader. The *Technical Index* is one dollar a year.

Alkali Lands.

BY PROFESSOR E. W. HILGARD, UNIVERSITY OF CALIFORNIA.

The present bulletin, an appendix to the report for the year 1890, and a reprint or second edition with added matter, is in this second issue, evidence of its value to those owning and cultivating lands saturated with mineral salts.

Alkali lands are a sequence of infrequent rains, or no rains throughout a considerable period of each year. The same salts, sulphate of soda, chloride of sodium and carbonate of soda, are found everywhere or exist primitively almost everywhere, but as Professor Hilgard says, are washed out by rains, except in arid regions where the soil water rises to the surface in the dry season and is evaporated, leaving the crystallized solids.

There are places we have examined within 60 miles of San Francisco, where the surface was covered with a complete crust of "alkali," broken into cakes or sections by contraction, and vegetable life impossible.

The present treatise is to disseminate information respecting the treatment of such lands. The nature and effect of various waters for irrigation, or in short, explains what farmers and horticulturists should know in order to successfully use alkali lands.

It will be sent on application to the University of California, or to the State Printing Department at Sacramento.

"INDUSTRY."

JOHN RICHARDS, Editor.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

San Francisco.

Founded 1888. NOVEMER, 1892. No. 52

Local Notes.

The Union Iron Works will launch on Saturday, the fifth of November, the U. S. Cruiser No. 6, to be christened the *Olympia*. This, the fourth war vessel launched by the company, is of 5,870 tons displacement, 13,500 horse power, armor protected, and to have a speed of 20 knots an hour. Her main armament will be four 8-inch, ten 5-inch breech-loading rifle guns. The auxiliary armament will consist of fourteen 6-pound, and six 1-pound rapid firing guns, and four Gatling guns. The launch will take place at 11:25 A. M. on the date named. The next launch will be of the battle ship *Oregon*, 10,200 tons displacement.

The Pelton Water Wheel Company, of this City, have issued a fifth edition of their catalogue or general circular containing a large amount of added matter pertaining to water power, and connected hydraulic subjects. The book is very complete in every way, finely printed, and has the exceptional merit of being written in the third person, or as we may say, in the impersonal pronoun, and thereby escapes a defect almost universal in such literature. Advertising literature has in other respects made wonderful advances during some years past, and it seems strange that this obvious rule of good taste and conventional usage is so often violated. The present catalogue is by far the most useful issued by any firm or company engaged in this line of business, containing as it does voluminous references of various kinds, and a large number of essays by different people, that assist in a proper understanding of water power and its accessories. It is 7 × 10 inches and contains 100 pages of matter.

The Union Gas Engine Company, of this City, have issued a special circular relating to launches and engines therefor, also marine engines employed as auxiliaries on schooners and other water craft to enable them to enter and leave ports, also to be used in the case of calms at sea. The list of launches fitted up is more than sixty, and the testimonials go to show a very satisfactory service all around, which in the case of launches, is a marvel. In nine cases out of ten such engines are to be cared for by people unskilled in such matters, and the success of the company's engines, under the circumstances, is an evidence of attention to all details. The company have made and sold over one thousand of their engines, so the industry is one of first-class importance, and rapidly increasing. We have watched the development of power-driven launches here since the beginning, and by the law of "survival," the gas engines are a long way ahead at this time.

The Fulton Iron Works, Messrs. Hinckley, Spiers and Hayes, by accounts in the newspapers, have been settling here and there all around the City, now, it seems, have definitely concluded to go to the only real advantageous site of all, on the north coast at Harbor View. The wonder is that some one or more of our crowded engineering works have not long ago moved there. It is the geographical *entrepot* of the City, with abundant land having just the desired slope to the water. The maintenance there for some years past of a public landing wharf is evidence that the swell is not an objection of much importance, even with open water, but if it were, other advantages compensate for enclosing a basin by some kind of breakwater. For docking purposes the advantages are obvious. A "haul out" slip, for one thing, would be continually engaged on yachts and the smaller craft of the bay. The only direct seas are from north winds, which blow only a few days in the year, and do not reach a gale oftener than once in three years.

It is reported that the Secretary of the Navy will recommend to Congress the construction of a Government drydock at San Francisco, which, of all ports in the United States, most needs one. The dock at Mare Island is for construction and repairing purposes, and is not available the greater part of the time for cleaning vessels, which is a frequent requirement in Pacific waters. The dock, if made, will no doubt be on Government land, of which there is enough, surely, and we hope to be spared from another case of purchasing land for public works in this City. There are abundant places on the north coast, or on the islands. The beautiful cove above Lime Point on the Marin side, must fill all the natural conditions required for a dock, in fact is a situation, all things considered, that should long ago have been put to some use. There is protection, deep water, flat lands, and accessibility in its favor.

The Traffic Association of San Francisco, acting upon wiser conclusions, and perhaps on some suggestions given in this Journal, have taken to transacting their business within their rooms, instead of through the newspapers, and have prospered accordingly. Some effects are now seen, and it is time, when the high seas are converted to monopoly routes between here and New York. It is a sad comment on our internal economy, that merchants in San Francisco should send goods to England from New York, and then ship them back here to save freight. Viewed in the abstract it is disgraceful, indicating, as it does, the operation of regulations and circumstances directed against the very existence of commerce and industry on this Coast, and causes one to stop and consider what use a canal between the oceans would be worth, unless safe from discriminating or excessive tolls. If the high seas are impressed into service for exaction, what could be done with an inland waterway?

The Marshall Window Furniture Co., a manufacturing enterprise in this City, has suspended business, and we make the circumstance an occasion for saying that a great deal of money and disappointment could be saved if we had here reliable consulting engineers; not only to pass on technical matters, but men skilled and experienced in manufactures, and especially by wide observation, capable of detecting the economical value of new inventions, and the local circumstances favoring or preventing their manufacture. In the present case, for example, an experienced mechanic, with some knowledge of market tendencies, and the ultimate merits of a spring window-balancing device, would have saved the investment in this enterprise. Some years ago there was written, for the Industrial Notes of this Journal, an analysis of this spring window balance, which had accidentally come to notice. The matter was not published, because it was learned there was a factory here for making the device, and the objects of the article might have been misconstrued. It was simply to show that, among all mechanical devices, none were more perfect than a counterweight, cord and pulley, and nothing further was needed for balancing window sashes, also pointing out that the change in the methods of manufacture to suit this device were nearly impossible.

COMMENTS.

The eight hour law recently enacted by Congress, is in keeping with some other economic legislation of the kind, and is nearly a century too late. It is nearly that long since wages and the prices of commodities were fixed by law, and the present act may be called a revival or "Renaissance" of the system. A law that stipulates how many hours a man should work, should also determine if he work at all, and also how much his wages should be. The latter is indeed included in the Act, one may say, because in day work the wages are paid for time or in proportion to time, one being a measure of the other. There is scarce a doubt but that the inception and objects of such legislation is pure demagogism to catch votes. If the Government works are to be operated on the eight hour system there is nothing to do but to make such a regulation, or continue it rather, without a special law to that effect.

The Government of Victoria finding themselves short of money, have attempted to increase their revenue by raising the custom rates, which since July last, has been about fifty per cent. on staple commodities. This may for a year increase their revenue but after that will no doubt reduce it. The people there are strong believers in what is called the protective system, that is to keep out imports so they will be compelled to make all kinds of commodities in the colony, but they also want revenue, and the query arises how they are to do both. If importations stop, so will the revenue. The two things are diametrically opposed to each other, and one or the other must be given up. New South Wales has been experimenting with an *ad* *valorem* tariff of ten per cent., which by all accounts does not seem to operate very well, and will no doubt be discontinued. The aspiration of these Australian colonies to make all their own commodities, is natural in one sense and unnatural in another sense. Whatever they have natural resources for can be made, otherwise not, without loss and failure in the end.

If the savage nations of the earth were to search for some proof that the English speaking races were no wiser than themselves, they could point to modern advertising methods. There is something unaccountable in the fact, if fact it be, that the judgment or choice of people can be influenced by the catch displays common here and in England, especially in England, where the advertising, considered in the abstract, would lead one to suppose the people were fools. We remember a remark made by a Swedish gentleman who on first arriving in a London railway station, inquired in amazement who furnished all the display pictures there. When the matter was explained he said, "They must sell their goods very dear to afford this." The latest thing there in the advertising way, is to use the clouds. These are plentiful in England, and cheaper than walls or hoardings. Views are to be thrown up with powerful lanterns on the clouds, by a company that has patented the method. It is a good rule and a safe one to never buy anything from a firm that resorts to sensational advertising.

Out of some scores of calculating machines since the time of Babbage, there is now for the first time some promise of application for such machines. Several forms are advertised for sale, one of them, which may be called a revolving or "circular slide rule" having some new functions, possible by reason of a more extended and complete adjustment of the scales than a rule permits. It is difficult to say what the ultimate effect would be of an extended application ot machine counting, perhaps none whatever, in so far as substituting mental application, because those who employ the slide rule, for example, never do so because they cannot compute without it, but to save time and labor. In fact it is to be doubted if among engineers who employ the system, there are any at all who do not begin by analyzing the nature and principles of the process. In the case of commercial machines for adding, dividing and apportioning wages and so on, it may be different, but such can hardly be called computing machines.

In several of our contemporaries appear articles on the "want of work," and views of the causes thereof, but no one concludes that want of work is due to a want of consuming, and a want of consuming an inability to purchase, and the whole sequence of commercial obstruction. The vigorous Caucasian produces at least a third more than he consumes, and the surplus must go out to the less skilled, or to parts of the world where natural resources are undeveloped or unsuited to similar production. This is the law of exchanges, but when choked by shifting and augmented prices, or by obstruction of any kind, then production must be contracted and there is a "want of work." By such exchanges all countries advance together, and purchasing power keeps pace with production, and there is no want of work, no overproduction, which means high prices and under consumption.

Professor Louis M. Haupt, an eminent, perhaps the most eminent, authority in this country on the subject, says the Canadian Government will soon have completed an inland waterway for deep-sea vessels, from the St. Lawrence to the center of the continent, reaching all American Cities on the Lakes, and placing us at a great commercial disadvantage. He also estimates that an equivalent system on our side at a cost of 150 millions of dollars. This is no fanciful picture. These waterways are a great fact. There is a revulsion just now against railways and in favor of waterways all over the world, but just how we are going to construct great canals across the eastern end of the continent against the railway interest, is a problem that even Mr. Haupt cannot make clear, especially as no one seems nowadays to care much about national matters of the kind. For such purposes we need Congressmen elected "at large" not "Representatives" of a particular constituency; National Congressmen we mean, who can understand and deal with problems like the above.

In the great railway convention held at St. Petersburg, Russia, in August last, it is significant to notice that the technical papers presented were in the majority of cases by railway officials, who in this country are not supposed to know much of anything of such matters. Sir George Findlay, general manager of the London and North Western Railway in England, treated upon "Permanent Way," Sir Andrew Fanbairn, of the Great Northern Railway, on "Crank Handles;" Mr. Lambert of the Great Western Railway, presided over technical discussions. The French representatives were equally learned on engineering points. We have in some cases in this country elected engineers to railway management, but not many. A. J. Cassatt, of the Pennsylvania company, for one. The capacity of engineers for administrative work none will deny, but the objection to them is they deal with facts and figures instead of "finesse," consequently cannot cope in schemes, with what we call commercial men.

The announcement that the U. S. Government have decided to adopt the Krag-Jorgensen magazine rifle for the army is certainly an unexpected circumstance, considering the amount of invention in small arms and implements for their manufacture, devised in this country. The statement is taken from a foreign journal, and if correct, admits of the question whether such decisions are arrived at without such publicity as would bring about home emulation in the case. If there have been competitive tests, they have been very quietly made when one has to learn from a foreign source that a rifle invented in Norway has been chosen as superior to any produced in this country. We reserve the privilege of believing that the requirements of the army could have been best supplied by American inventors, and that they should enjoy a full measure of that "protection" furnished by their own skill. It may be that our own resources are not sufficient, but we do not believe it.

A drainage scheme in Florida, near Tampa, has been organized in New York for the reclamation of lands along the St. Johns River. The tract is over eighty miles long, three to twelve miles wide, and the estimated capital required is $4,000,000. The land is covered with, or formed of river silt and decayed vegetable matter, and will be suitable for sugar cane or other crops such as the climate will permit. There are unquestionably great areas along the rivers and lagoons of the Southern States that can be reclaimed at moderate expense, but there is the problem of malarious fevers to be dealt with by those who live on and till such lands, there is also the problem of uncertainty in respect to sugar cane culture. It is not a profitable industry when the cane has to be planted each year. A great many of the Louisiana plantations have been changed to rice culture and have proved more profitable thereby. Between frost and yearly planting the sugar industry has to be sustained by a subsidy. There is more promise in beets at this time.

Industrial Notes.

Modern steam-engine economy is illustrated by a circumstance that happened a short time since, when the Buckeye Engine Company, at Salem, Ohio, telegraphed to Mr. A. L. Fish, their agent here, to guarantee a horse power of duty with a consumption of 16 pounds of water per hour. It was, of course, assumed or stipulated that the steam should be dry, and furnished at some initial pressure, which we do not know, but the circumstance shows the wonderful advance of five years pass. The Company named are responsible in every way, and whether others will assume similar contracts we do not know, but the circumstance in itself is remarkable, the amount of steam or water being within less than three pounds of the best results recorded for laboratory experiments.

The *Australian Mining Standard* gives an account of a vacuum apparatus for dredging in the bottom of streams. Steam being employed at 5 to 7 pounds per inch to fill a vessel, which is then sprayed, the steam condensed, and the vessel filled with silt by suction. The *Mining News*, Seattle, proposes to investigate the matter, but we think need not. The method would have answered in Captain Sarvary's time, but it is more than a century too old. No one with any regard for fuel waste would think of such a method now, even if any reasonable capacity could be obtained. Steam and cold water applied in one vessel may answer for cases of emergency, in what is called the pulsometer for example, but for continuous dredging a regular centrifugal pumping plant of equal cost would do more work and do it cheaper.

The failure of an iron bridge at Strathglass, in Scotland, which fell or gave way before finished, and while the filling or roadway was being put on, is the subject of much comment in our English contemporaries. The bridge was 130 feet long, 18 feet wide, computed to bear 37.5 pounds per foot of roadway. The girders were 130 feet long, of lattice form, and weighed each 47,000 pounds. The top member had a section of 19.5 square inches, subject to a compression strain of about 15,000 pounds per inch, which is, as *Engineering* says, permissible, but there was no adequate provision to prevent "buckling," and this was the cause of the failure. The limits laid down for rigidity of such compression members is that their width should be from one twelfth to one fifteenth of the distance between supports, while in this case it was practically as 1 to 130. The principal fact in the case is, no doubt, that a responsible firm bid for the work at £2,030, and the constructor of the bridge at £1,290, a difference of £740, or nearly 40 per cent. less.

The importation of hydraulic cement in this country is a reflection on our skill. The amount is about three million barrels annually, and is sixteen per cent. of all that is made in Europe. Here, in California, a number of attempts have been made to found this business, most of them failures, and if we are to accept reliable opinion on the subject, it is because of faulty processes, and the want of intelligent care over the work. Fuel is dear, but not dear enough to counterbalance transportation from Europe or from the East, and natural materials are certainly not wanting. If chalk is required, it could be brought here at a low cost as ballast. There is a duty on it, but this, like the tax on quinine, was arranged on general principles, and should be taken off, because no chalk is found on this continent. We have always thought, without any chemical knowledge of the subject, that "slickens" and chalk constitute elements for cement. Chalk and Thames mud are used at London, and this latter named material is certainly no better than the debris deposited here in the bay.

Messrs. Westinghouse, Church, Kerr & Co., make the following statement in some of their recent advertising matter:

"The compound engine, when non-condensing, so far from possessing an economy superior to the simple engine, has been decisively proven, 'much to the disgust of the stockholder,' to show normal economy only at or about its rated power, and to fall off in economy faster than a simple engine as the load falls off; moreover, very much faster under the extreme light loads that are common at times in many industries. This point is at last reluctantly admitted by the more candid builders of such engines, most of whom now advise against compounding for variable loads. The reason is in their inability to divide the load and range of temperature proportionately and automatically between the cylinders at all points of cut-off. Hence the low-pressure cylinder expands its steam below atmosphere under a moderately early cut-off, thus converting itself into an air pump, and becoming a load upon the high-pressure cylinder instead of a co-laborer with it. This point was distinctly foreseen by the designers of the Westinghouse compound engine, and an entirely new principle was worked out, making expansion below atmosphere impossible under any load however light."

Mr. F. M. Rites' paper, read before the meeting of the Mechanical Engineers held here in May last, made this matter plain. It has proved itself by actual working in many cases.

Mr. Robert McGlasson, of London, who has, for some time past, been vigorously presenting a scheme for reversing the blades of propellers instead of reversing the engines of boats and steamers, has contracted with Messrs. Priestman, of Hull, England, for the use of his propellers. Messrs. Priestman Bros. are makers of petroleum engines and launches, and as such engines are difficult to reverse, the invention will succeed in their case if at all. Time will show how nearly we are correct in assuming that no loose mechanism or moving joints can be successfully maintained on or about a propeller. Between jar, salt water, and the inevitable "knocks" that propellers receive, there is little chance of holding loose blades however well the parts are fitted and however strong they may be. This far petroleum engines have been reversed by means of gearing on the screw shaft, or between the screw shaft and the engine, and this too is by no means a desirable arrangement.

An inventor in England proposes a street conduit for an electric railway, consisting of a trough with a slit in the top one and a half to two inches wide for the trolley, the slit being covered over with a continuous strip or bar resting on ledges at the sides of the slot. This bar when in place presents a flush surface, and is flexible enough to be lifted as the trolley passes along. The bar goes through an aperture in the trolley frame, and is raised only two inches or so at the extreme point, and falls back again as the car passes. The invention is considered important enough to occupy a good deal of space in the technical journals, but, we imagine, will be found rather disappointing in practicc, unless employed in streets cleaner than any we have any knowledge of. The fact is that moving joints or adjustments of any kind at the surface of a street, exposed to the traffic, mud, rain and gravel, are not likely to endure for any time, besides the loose covering bar will, no doubt, "crawl" with the traffic and cause difficulty. The proposed system is the invention of Mr. Brain, of Liverpool.

Mr. Linforth, of French & Linforth, of this City, brought in, recently, a common pipe "union," externally the same as the standard fitting, but internally with a difference that goes to show how small things are overlooked. These unions consist of three parts, two thimbles and a screw-collar to unite them, but one nipple has a collar of lead around its end fitting into a concave seat in the other thimble. The face of the lead collar is spherical, and it comes down to a fit, forming a perfect joint without loose packing. If these unions had been invented twenty years ago there would have been much time and profanity saved, not to mention leaks hard to avoid with the common fittings of the kind.

In some recent experiments with current wheels, conducted by Prof. Unwin, he concluded that the efficiency attained was about 11 per cent. He claims that the computable efficiency was 32 per cent., but that 21 per cent. was lost in friction and by imperfect application to the water. The apparatus was a chain with floats attached, and unless there is some mistake the result is wholly discouraging. It, however, conforms to what we commonly learn of the power of float wheels, which never yield only a small portion of the power they are expected to give off. The difficulty seems to be that the mobility of the water permits it, when not confined, to pass around the floats without imparting but a portion of its energy.

The Day gas engine, arranged to compress the charge by its back stroke, noticed in this Journal some months ago, seems to have, as was then suggested, some points deserving attention. The only feature that seemed questionable was driving out the spent gases by the new charge, without, at the same time, wasting some of the unburned fuel. This seems an insuperable difficulty, but if in practice such loss can be avoided, the Day engine is an innovation that will soon come to the front. An impulse at alternate revolutions, or driving one stroke out of four, is a very undesirable characteristic of modern gas engines. It demands a double capacity in proportions, and the motion or force is so irregular as to demand fly-wheels of still larger proportions than the engines. The increment of heat by increased explosions, as well as other conditions of the method, seem to be overcome by the makers of the engine above referred to. One peculiarity of the Day engines is that they will run equally well each way.

We have received, from a friend in Sweden, a circular and descriptive matter relating to steam turbine motors as constructed by Mr. Gustaf de Laval, the inventor of the centrifugal cream-separating machines. These steam impulse engines were an early invention of his employed to drive the cream separators, which are almost the only machines in use requiring a speed approaching that of the steam turbine, as it is called. We are not able, from the drawings given, to understand how Mr. de Laval deals with the steam in respect to expansion, but the subject, as a whole, we may safely assume has been carefully studied in Sweden. We remarked, some time ago, that, in so far as constructive scheming, the Dow turbine, invented in this country, seemed to be the best of all, and the wonder is that nothing has been heard of it for some time past. Mr. Parsons, in England, is continuing his researches and experiments, and has had the advantage of bringing to bear, from the start, exhaustive scientific analysis of the impulse method as applied to gases.

Mr. Josiah Dow, in a paper contributed to the *Journal of the Franklin Institute*, Philadelphia, sums up the resistances in pumping water with reciprocating pumps, and, in so doing, assumes that the water in suction pipes follows the movement of pump pistons, stopping and starting at the ends of the stroke, which is certainly true in most cases but not in all, and it is not fair at this day to apply such a rule. The investigations of Prof. Riedler have disclosed these resistances in the fullest manner, and have led to an avoidance of them in pumps made after his designs. When a pump is working economically, the movement of the water can be compared to that of a boat impelled by oars, the oars representing the pump piston. In like manner a pump working imperfectly can also be compared to a boat being rowed when it is stopped at each stroke of the oars, the momentum being lost. The fact is, pumps need reforming altogether, so the flow of water through them will be continuous and the piston act as an intermittent impelling agent to maintain a constant flow. Then the piston movement can be 300 feet or more per minute, instead of 100 feet as is common now, and the capacity of the pumps would be increased accordingly.

Miscellaneous.

The present construction of war vessels by the principal powers is set down as follows: England, 10 ships, 134,200 tons; France, 14 ships, 94,830 tons; United States, 9 ships, 54,060 tons; Russia, 8 ships, 77,520 tons; Spain, 5 ships, 39,470 tons; Germany, 5 ships, 24,400 tons; an aggregate of 424,500 tons, which at $150 per ton, with armament, makes up $63,675,000. These, it must be remembered, are new ships in process.

In the great railway convention recently held at St. Petersburg, Russia, where accurate statistics were presented, it appears that the United States has 167,755 miles of line, and that the sum total of all countries is 385,803 miles, so that about 44 per cent. of the whole is in this country. The causes of this are many. This and all new countries lack common highways which are the work of centuries in the older countries, and we depend on railways instead. The same remark applies to the improvement of water ways, which was making much progress in this country at the beginning of the railway era. Most of all however in this country has been favorable laws and regulations to promote railway construction, and the hemming in of capital that had no other domestic outlet. There is also much in methods which are peculiar to this country that have enabled railways to be constructed with small capital and yet be serviceable.

The Commissioner of Patents, in a recent decision, says: "where one has conceived an invention and discloses the 'essence' of it to another whom he employs to develop and perfect it, 'suggestions' from the employee in the course of experiments and 'dependent on the main idea,' will not, *ordinarily*, give the employee any rights as an inventor." These are guarded words, applied to a problem far from clear or settled. The qualifications found in the quoted words above, shows how careful the Commissioner was to distinguish between a case when the original had done no more than discovered a "want" and suggested some way, or one way, of filling such want. The circumstances in all such cases when set forth will indicate the amount of inventive claim that exists on either side. There is, as a rule, no difficulty as to fact, but there is difficulty in forming any general "rule" by which disputes of the kind can be settled.

On the first of this month there goes into effect in England, a very important regulation respecting the taxes on patents. The original fees remain without alteration, but the maintenance fees or tax is reduced a third or more and payable in a different manner. The first tax fee of five pounds sterling is to be paid five years after the issue of the patent, and then continuing yearly, rising one pound each year till the end of the term of fourteen years.

The Yuma Canal in Arizona, by which the Colorado River is diverted through a tunnel, is the most extensive project of the kind in this country. The scheme involves a canal 90 miles long, 100 feet wide at the bottom, and 12 feet deep. We imagine that there is nothing more than a survey at this time, but the scheme is, no doubt, in shape to be taken to England and sell. The purpose is irrigation, and the area commanded is said to be two millions of acres. Those who have seen the Colorado, at Yuma, in the dry season will wonder where the water is to come from to fill a canal of the dimensions stated.

The Corliss Steam Engine Co., at Providence, R. I., have recently forged and finished an engine main shaft, 26 feet long, 22 inches diameter, that weighs, with its integral fittings, 74,640 pounds. It is astonishing to know that facilities for such forging exist in a steam engine works. The shaft is for a pair of triple engines to drive a cotton mill, and will have a main pulley 28 feet in diameter, that weighs 155,000 pounds. The dimensions we take from an article in our contemporary *Power*, where the face of the wheel, above named, is set down at 184 inches, or over 15 feet, which is, no doubt, a mistake, at least it would not do for a shaft 26 feet long.

The Pennsylvania Company, it is claimed, have decided that metal railway ties or sleepers are more expensive than oak, and no more will be laid. There are other objections than cost, but it must be remembered that this proves but little respecting metal ties. The Pennsylvania lines traverse for the greater part of their routes, an "oak country," where superior ties are cheap and almost inexhaustible. The Allegheny range of mountains and the slopes down to river levels are covered with oak, and the price of timber is very low. Few railways are so well provided. It is, however, doubtful if for many years to come metal ties can be profitably employed in any part of this country.

The vastness of the world's marine is indicated by the losses during the first three months of this year, of 183,400 tons of shipping, equal to 1,000 vessels of 183 tons each, which is above the average, because the number as listed is 284. Of these, 17,800 tons were steel; 81,000 tons were steamers. About one third of the vessels were wrecked; 25,000 tons were never heard of after sailing; 15,000 tons were lost in collisions. Only 35 vessels were broken up or condemned.

A suit brought by a large iron works at Pittsburgh, against the principal natural gas company there, to compel the fulfillment of a contract to supply gas as fuel is likely to bring out many facts respecting the supply of such gas that would otherwise be unknown. Mr. Cummins, who seems to be thoroughly familiar with the subject, estimates the total quantity of gas in the twenty gas districts around Pittsburgh at fifty billions of cubic feet. This is of course, a guess, but is made up from carefully observed data. The gas is collected in porous rock, and given off at a pressure of three to five hundred pounds per inch. Formerly the wells were not throttled when the gas was not required, but now this is done in all cases, and a great saving effected.

The Baldwin Locomotive Works, at Philadelphia, have constructed two locomotives for a railway in Sweden, weighing 68,000 pounds, cylinders 16 × 24 inches, driving-wheels 53 inches diameter. This order is creditable to the American makers. Swedish locomotives, except a few, have been made in England, or at least were down to a dozen years ago. Since then we believe a few have been procured from Germany. The main railways, or trunk lines, in Sweden are owned by the government, and the feeders or subordinate lines by private companies. The permanent way is hard to keep in order during the Spring, when the ground thaws out, and we imagine that American locomotives, being more flexible than English ones, will give good results there.

The workmen employed by Krupp's, at Essen, in Prussia, have erected a fine monument in memory of Alfred Krupp, the founder of the great steel works there. Mr. Frederick A. Krupp, one of the present proprietors, acknowledged, in an address, the kindness and gratitude of the men, and, at the end of his speech said the firm had given $125,000 to found a home for the invalided and infirm among the men, and the widows of those who died in the employ of the firm. The men, 17,000 strong, then marched past the stand. *Industries*, London, from which we copy this account, remarks: "Such a tribute is a contrast, indeed, to scenes in England and America, between employer and employed." The name above should, we think, be Frederick instead of Alfred Krupp.

A feature of much interest at the Chicago Exposition will be the fleet of Columbus reproduced. His flag ship, the *Santa Maria*, has been constructed by the Spanish Government in sixty-three day's time. It is a grotesque-looking affair. Two other vessels will be built in Spain at the cost of the United States Government, the *Pinta* and *Nina*. The *Santa Maria* is about 100 feet long, and her tonnage 130. The vessels are to cross the Atlantic under convoy, engage in a naval review at New York, and then be taken to Chicago. It is hard to conceive now of the causes that developed such an extraordinary design for sea-going vessels. With their top hamper they would be blown to "smithereens" in a North Atlantic gale, and as to working to windward, no such thing could have been thought of.

The immortal Captain Bunsby being dead, and no longer available to unravel knotty problems, we feel constrained to assume his functions so far as to answer an economic problem we find in several of our contemporaries, namely: "There is no duty on anthracite coal, but it is the subject of a gigantic trust. There is a duty of seventy five cents a ton on bituminous coal and it is not 'trusted.'" The petroleum trust is also cited as an example where an import duty does not support a trust. Our answer is, that a trust depends upon the power of confining consumers to one market or source, from which to buy. and as this can be done in the case of anthracite coal and petroleum without a duty, because these things are not imported, we fail to see where the query comes in. The difference is in the means of shutting off the consumer. The principle is just the same. No trust can be maintained in any country in respect to commodities that are in the open markets of the world, without an import duty to protect the trust.

Some time ago there was printed in this Journal some account of an engine by Bolton and Watt, made in 1813, that was in use down to 1880 in the Bun Hill Brewery in London, but it now appears by a description and drawing in the *American Machinist*, that there is a similar engine in use in Savannah, Georgia, furnished by Watt in 1815, that is yet in use and doing good service. It is a beam engine of 90 horse power, the cylinder 30 inches bore and six feet stroke, low pressure condensing, runs at 18 revolutions per minute with 8 pounds of steam pressure. This is a very extraordinary case. An engine 77 years in use and by no means a bad engine yet. The design is symmetrical for a beam engine, except the connecting rod of cast iron, which looks clumsy, but the strangest of all is the analogy to our steam-boat beam engines, in respect to valve gearing, condenser pumps and other features. The parallel movement of the piston is produced by links on the well known Watt method. It would be interesting to know something of the efficiency of this engine compared with modern types, but nothing is said of this in the description above referred to.

"Industrial Notes," in *Engineering*, London, has lengthened out to one and a half pages of nonpareil, and in a late number begins with a portentious forecast of the situation in England, which is no better than here, perhaps worse, because strikes there are more persistent than here, and more determined, if less violent and lawless. In the note, above referred to, the claim is made that the forces at work are like a volcanic eruption, and pervade all trades. There is no use whatever of homilies on the causes of modern labor disturbance. People drift with circumstances, and will continue to do so. In all voting countries, where one man is as good as another, the labor element have at command a force that permits almost anything they want or demand, and they are fast preparing to elect their side in several countries, and then will come the real struggle.

An inventor in England proposes, or has indeed applied, a dredging machine that deserves attention everywhere. It is called an eroding machine, that by rotary action digs up and pulverizes the bottom, so the spoil is carried away by the current without lifting. In one case 10,000 cubic yards were removed from the bottom of the Witham River at a cost of one and a half cents a cubic yard. The cost of removing the hardest boulder clay is estimated at five cents a cubic yard. There seems no doubt that wherever there are currents, even weak ones, there is economy in pulverizing below water and letting the current do the lifting and carrying when there is a dump or outfall for the debris.

Mr. S. V. Powderly, President of the Knights of Labor, who has been elected a member of Congress, has summed up that body and its proceedings in a manner that should command public attention. The charges of T. E. Watson respecting intoxication, Mr. Powderly says, are true and just as he himself saw the circumstances. The main point however in his description is a remark on the "representative" system. He says: "An average constituency is just as dishonest as its representative, for it requires that he drive his fingers to the bottom of the national purse in order to dredge the river next to his home ; to erect a public building over a town lot, so that some speculator can sell the surrounding property to good advantage."

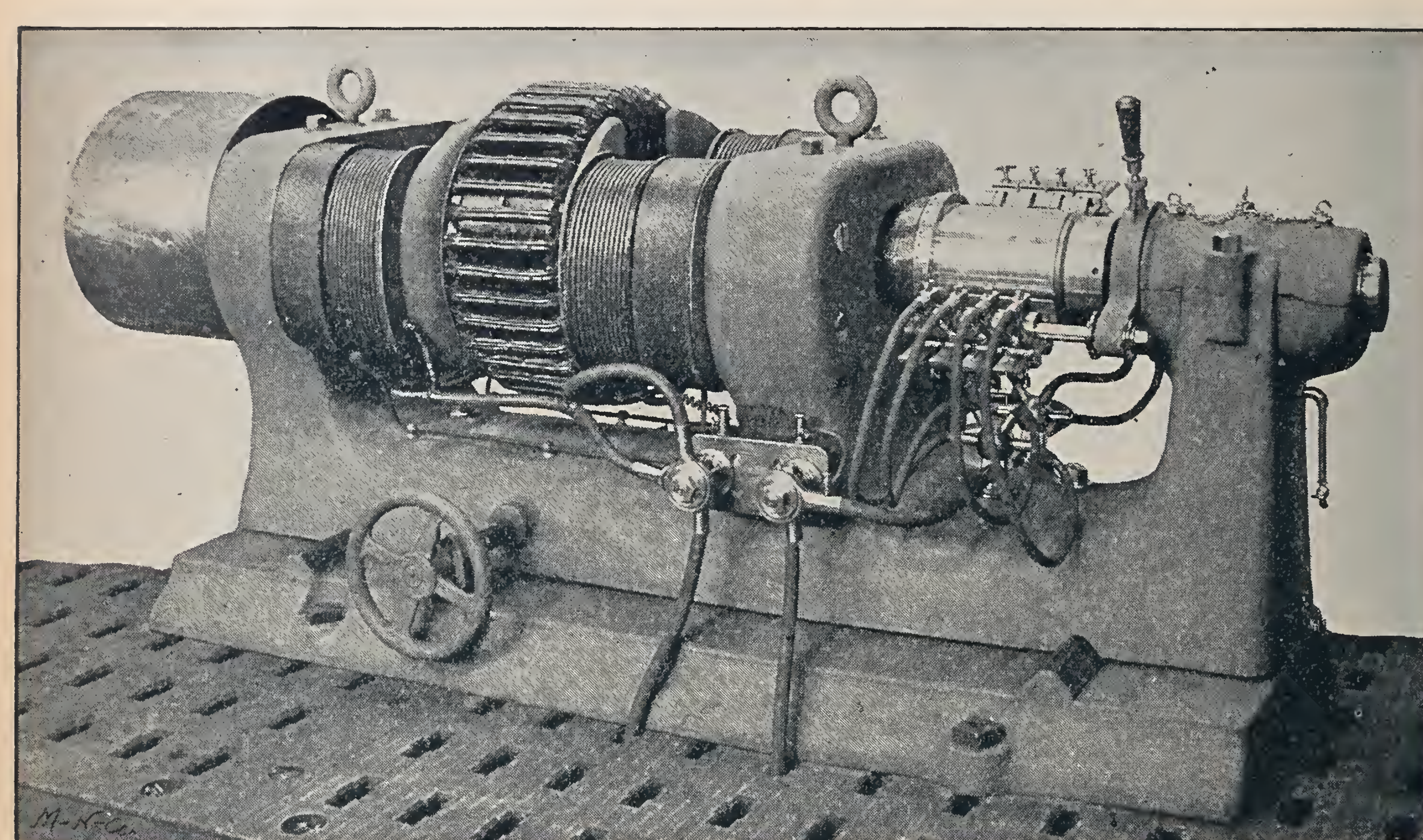
Some years ago the California Electric Light Co. here fitted up a Westinghouse air brake compressor pump, to clean their dynamos by means of an air jet. The method was entirely successful and can no doubt be applied with advantage in a good many other cases. By a note in one of our exchanges it appears that the same thing has been applied in Portland, Oregon, to cleaning railway cars, and if practicable is certainly better than swabbing with water, in this climate at least. In the matter of dust, water may seem more effective because it plasters down the dust not removed, but it comes up again when dried. For the running gearing of railway cars there is certainly no way of so conveniently and quickly removing dust as by a strong air jet, also the interior of passenger carriages could be cleared of dust in this manner expeditiously.

The British have a very practical way of making the travelling public foot the bills for improvements. There was, on and after August 1st, of last year, a poll tax of one shilling a head assessed on all passengers crossing the Channel between Dover and Calais, for the purpose of constructing a new harbor and pier at Dover. This seems an incredible proceeding as an Act of Parliament. The French have the same right, provided they own boats in the traffic there, and perhaps another shilling will be added at Calais, but the main question is, if the works are constructed with the passenger's money who will the works belong to. It is a tax on the world, so to speak, because all nations cross there. It is, of course, something like a port charge, but this is not usually assessed before the port is made, because those using the improvement are the proper persons to pay the tax. The scheme is unjust and illogical.

The tunnel beneath the city of Baltimore to permit continuous traffic through that city by the Baltimore & Ohio lines, is a stupendous affair, for which six millions of dollars was provided, and which sum will be much increased before the work is done. The cost was computed on the basis of the Pennsylvania Company's tunnel around the northern or western side of the city, but the new tunnel is lower and has developed a great deal of water, requiring the whole to be arched with masonry. Baltimore should be called the Tunnel City now. It has more underground railway than any other, and more than any is likely to have. The city is situated between the commercial and political capitals of the country, so the through traffic is enormous and fast. Nowhere else are trains driven with so great speed, and there is no time for detours or water transferring, so the lines have to go under the city.

Messrs. Escher Wyss & Co., of Zurich, Switzerland, have constructed a yacht of aluminium, 43 feet long, 6 feet beam, with naptha engines, such as were adopted here at first for launches. It is said to be a fine piece of work, and is no doubt, except the engines, which may be fine also, but if no more successful than they have been here, some other kind of motive power will soon be wanted. The boat was built to the order of Mr. Nobel of Paris, and from a drawing published, is by no means such a graceful design as one would expect from a firm that builds fifty or more launches each year. The present is perhaps the largest boat made of aluminium to this time, and will prove nothing beyond the affluence of her owner. The cost must be excessive, and except as to corosion, we can see no gain in using aluminium for a hull.

The total number of artesian wells in the Western States, or western half of the country, is given in the Census at 8,097, more than one half of which are in California. Of these 3,930 are for irrigation purposes, watering, on an average, 13.21 acres each. The average discharge of wells is 54.43 gallons per minute, and their average depth 210.41 feet. The average cost of each, $245.58, and the total capital invested in wells is set down at nearly $2,000,000, and is, no doubt, much more, if abandoned wells are included. These statistics are not very reliable, because of the difficulty of procuring facts respecting wells, but are as exact, perhaps, as any that can be compiled.



ELECTRICITY.

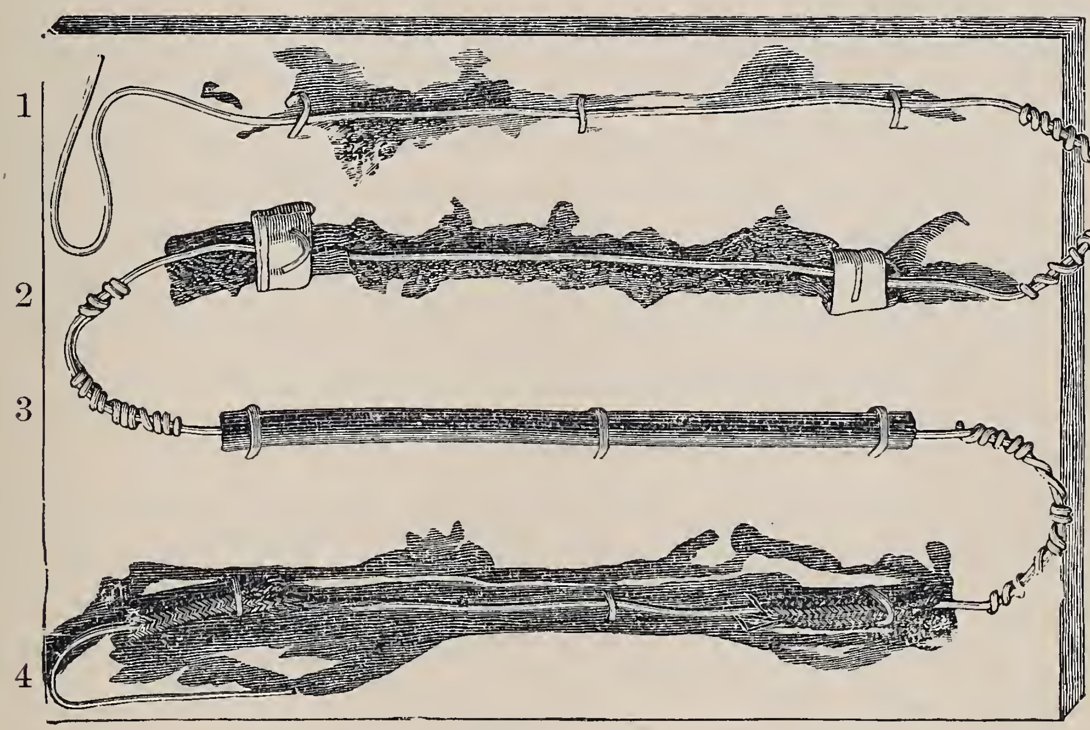
DIRECT-CURRENT INCANDESCENT DYNAMO.

THE BRUSH ELECTRIC CO., CLEVELAND, OHIO.

The design above is one recently brought out by the Brush Company for incandescent lighting, and is analogous to, but an improvement in both constructive and electrical features over the well-known Brush generators.

The bearings of the armature spindle are shells, not split, provided with trailing collars for lubrication, and have the form and arrangement that has been found best in high-speed machinery. At first the makers of dynamos not being accustomed to high speed, came far from providing for it in the bearings of their machines, not that a dynamo is a high-speed machine by some other standards, but far exceeded what was common in engineering works, and the bearings were faulty accordingly.

The armature above, as may be seen, is nearly as large as the magnetic circuit. It contains thirty-six bobbins, and is made of thin wound iron ribbon. The cummutator brushes are made up of thirty-six bars of pure copper. These dynamos are made in nine sizes, from four to sixty horse power, and, as before said, conform in all essential features to the Brush type, having a long spindle, with lateral field magnets, reducing the machine to the smallest possible dimensions in its cross sections, and distributing the mass parallel to the axis of the armature shaft.



A NEW METHOD OF INSULATION.

The Washburn and Moen Manufacturing Company, of Worcester, Mass., through the Pacific Coast Agency, in this City, sends the above drawing from a photograph, showing the result of some tests made to determine the endurance of insulated conducting wire made by that Company. This wire is shown in Fig 3 above. The several figures show the result with the different brands of insulation, after a test which is thus described in the *Boston Morning Journal* of Sept. 10th, 1892 :

"A series of wires, including the popular kinds of insulation now in use, were joined together and firmly fastened to a board. The new "Salamander" wire, which is being introduced by the Washburn & Moen Mfg. Co., of Worcester, Mass., was joined in like position. The sizes of all the wires were No. 14, Brown & Sharpe's gauge. Then a strong current of electricity was applied, amounting in electrical language to 125 ampheres, increasing to 140 ampheres. The circuit of wires turned first red, then white hot, and the Salamander insulation alone stood the test, the others burning into crisps. The heat was so intense that the wires actually fused, yet the insulation of recent invention was not only unburned, but the rubber interior surface retained its peculiar quality, thus showing that the heat had not even caused deterioration."

This test was made in the Electrical Engineering Company's laboratory in Boston. Other tests of a similar kind, and with like results, by the Equipment Bureau of the U. S. Navy, also at New York and Chicago, by competent authorities, leaves no question respecting the extraordinary resisting qualities of the insulation.

The importance of the invention lies in the immunity from danger of fire by overheated wires, and we need but to recall the many serious losses of the last few years to show the result of imperfect insulation. The fire on the steamship *City of Japan*, and the lost Western Union Building in New York, are two noteworthy instances. This wire can be examined at the Company's offices, 8 and 10 Pine Street, in this City.

NOTES.

In the late meeting of the British Association, one attending might have thought it an electric convention, because the electric section consumed so large a share of the time. Not less than twelve of the members presented papers, or made addresses, on subjects connected with electricity and magnetism, and all the matter, as might be expected, was new, or advanced, and of much interest. Mr. Preece's paper on "Earth-Current Storms" was a marked contribution. Nomenclature came in for another debate, and properly too, because it is important that we have at least one science and industry not saddled with irrelevant names borrowed from other places.

A Hamburg firm, makers of electrical machinery and steam engines, have brought out a dynamo and engine much nearer together than has been done before. The spindle or shaft of the dynamo is made with a crank at one side of the armature between the journals and the engine connected there, avoiding a good deal of expense, and saving space without incurring any objections that can be seen. The common plan is to construct both an engine and dynamo complete, set them on a bed-plate, and couple the two together, but there seems no sufficient reason why there should be two shafts, extra bearings, and a coupling, when, as in the case above noted, the machine can be made altogether as a whole.

MINING.

TIN IN THE MALAY PENINSULA.

[From the Mechanical World.]

"Mr. Leech, an official in Perak, in a recent report describes a new method of tin mining which is being adopted in that State. He says the system of mining in Kinta, during the last year, has completely changed owing to the introduction into general use of short wash-boxes. Up to the end of 1890 they were hardly known, now they are used everywhere. The wash-box employed formerly was 30 feet long, and could only be used with a considerable head of water; a 6-inch steam pump could only keep two boxes going, and, as a natural consequence, only land in the neighborhood of large streams of water, or in which the owners could afford steam or water-power pumps could be worked. Considerable capital was, therefore, necessary to open a mine, and the only part of the land worth washing was the karang or rich tin deposit, found at a depth of from 10 feet to 50 feet below the surface. The introduction of the short wash box has changed all this. The box itself is but 8 feet long, and costs about 16 shillings. It can be put up wherever there is a pool of water, instead of requiring a steam pump; it can be supplied with water by one man ladling with a kerosene tin, and instead of thousands of dollars being spent on stripping the surface soil before the karang could be reached, the surface soil itself is now washed in the new boxes, the same water being used over and over again, and the mining coolies earning from 1s. 3d. to 12s. 6d. a day each. Five or six men work to one box. Owing to the small quantity of water used under this system thousands of acres of land, which were formerly looked upon as unproductive, are now being worked, and the amount of payable mining land in Kinta has become practically inexhaustible."

THE DEBRIS PROBLEM.

The recent decision refusing an injunction to restrain the North Bloomfield Mine from operating their works and property, is another step in the endless law procedure that always follows special enactments. If the courts are to be set up as an authority for methods of restraining debris, its consistency when permitted to escape, and so on, we are in the middle of a muddle which will have no end.

Under organic laws, the mining companies have a right to determine their own methods, and deal as they please with their own property, so long as as they do not damage the property or infract the rights of others. To determine this damage is as easy in one case as the other. It is the central problem of the whole matter; but it is not the province of a court of law to define methods of restraining works, or set up a vague standard for debris that may be discharged into streams. It would be an easy matter to have declared the amount of solids per cubic foot that should be permitted to escape, and thus remove the matter from the field of opinion and uncertainty, to some ground that could be understood and acted upon. The dispute, when reduced to its elements, is simply the amount of suspended matter that can be discharged in tail water, or sluice water, without damage to navigation or lands below the point of discharge. This amount, if not known, is a proper subject to be determined by experiment, expert opinions, or otherwise.

What the mining people really want, is no restraint. They want to wash down whatever contains gold, and let the debris take care of itself. If not this, they want the General Government to provide means of arresting the debris by dams. On the other hand, the farmers along the rivers, and those concerned in navigation, want nothing put in the streams, not even the water fouled, so there is no hope of any permanent settlement of the matter, except by recourse for damages, under laws and procedure that have been established for ages to determine such matters.

ORE CRUSHING.

The following, from the *Engineering and Mining Journal*, contains some important suggestions:

In many low grade mines an increase in tonnage crushed with an existing plant means not only a lower cost per ton of ore, but an increased revenue, which in some cases may make a venture profitable which otherwise would prove a loss. It is remarkable, therefore, that a preliminary coarse crushing by means of rolls, before the ore goes to the stamps, is not generally practiced. The only mill to our knowledge constructed on this principle is that of the Huanchaca Mining Company, at Antofagasta, Chili. It is difficult to say what the increased capacity would amount to, but it would certainly be over 20 per cent. Experiments at the Hermosa Mill, Harshaw, Arizona, proved that by screening the fine from the coarse, and charging that separately to the pans, the crushing of the 20-stamp mill was increased one fifth.

There are few mills using this precaution even; both the millman and the millwright are content to follow along in the same old groove. A mill properly constructed would have rolls on a lower level than the rock-breaker, crushing to say 4 mm. The crushed ore would pass through trommels, the finer go directly to the feeders and the coarse back to the rolls again.

The cost of running and repairs on rolls crushing so coarsely is merely nominal, while the benefit is pronounced. Not only would the capacity be increased and cost per ton lessened, but the feeders would require less attention and the discharge would be more perfect in either wet or dry crushing. It would not be out of the way either to have fine screens below the coarse trommels, so that the portion—no inconsiderable amount with many ores—might be sent to the pans or furnaces, as the case might be, without passing through the battery. It is almost time we should see some improvement in gold and silver mills, as we do in other reduction works; for the former, though far from perfect, are built today from plans twenty years old."

NOTES.

One of the daily papers in San Francisco recently contained a column or more of matter devoted to the discovery of coal oil at Sausalito, stating that sixty gallons of oil had been secured in twelve hours. Engravings were made to show the environment of the wonderful spring, and the story was copied in the *Engineering and Mining Journal*, the quantity of oil being set down at seventy gallons in twelve hours. We pass this wonderful well twice a day, and the fact of there not being a quart of oil altogether is not the main one in the case, that relates to the value to be placed on such news in a general way. There was, and is, certainly a little oil exuding from the bank referred to, as there is in hundreds of places in California, only this, and nothing more.

The Harney Peak Tin Mining Co. have, it is said, issued bonds against their whole property for the sum of four and a half millions of dollars to be expended in works. What provisions, if any, have been made to secure a proper use of the money thus raised we do not know, but if none, there is a chance, as a writer in Rapid City, South Dakota, says, that the money will find other uses. The Harney Peak Company is an English one, or at least the money expended this far came mainly from England, and it is likely that any tin mine bonds sold there will be closely scanned at this time. The long and short of the whole matter is that the tin ores of this country are not rich, and even if they were, it will be hard to reduce them at a price to compete with Australia, and other sources. The investments for plant will be a great deal more, so also management and expense. The labor would no doubt be the cheapest element of all, supplemented as it might be by improved apparatus and processes.

The invention of Alexis Janin, of this City, for the amalgamation of silver ores, is thus declared in the specification of his patent, No. 481,031, of August 16th, 1892:

"I have discovered that finely-divided metallic copper, or cement copper in such condition as it is obtained when precipitated from the solution of a copper salt by metallic iron, has a powerful effect in desulphurizing and rendering more easily amalgamated sulphides of silver when added to and stirred together with ore containing those minerals, and in the presence of an acid salt—such as alum or other salt of alumina—or of ferrous chloride or sulphate, or chloride of manganese. Other acid salts—such as sodium sulphite and bisulphate of soda—also promote the desulphurizing action of the finely divided copper, and the subsequent amalgamation of the silver by mercury. It is essential that the copper be present in the finely divided condition described, as copper-filings or larger pieces of copper would not have the same effect. I apply these facts to the amalgamation of silver ores in pans."

THE U. S. SIGNAL SERVICE.

Through courtesy of Lieut. J. P. Finley, U. S. Army, chief officer in charge, the editor had, last month, the privilege of looking over the offices and apparatus of the U. S. signal station here.

This system is one that derives its importance, and also its possibility, from the wide expanse of our country, and the lines of longitude and latitude covered by its stations; not that meteorology is local or national, except as to the daily phenomena that arise, because the science covers the atmosphere of the whole earth, with its constant mutations of temperature, movement, course, and force.

The system of observation, as conducted in this country, is one of which we may well be proud, not only because of its chief development here, but because it is a useful and important branch of public service conducted on a scientific basis, by men far above the plane of personal interests, and like some other departments, the Army Engineer Corps, Coast Survey, for example, stands as a proof that all we need in order to secure a pure and efficient Civil Service is to remove it from trade and private interests by placing it in charge of educated and competent men, selected by fitness and retained when successful. Whenever the national or public service is brought in contact in any way with prices, values, or trade, or, in other words, private interests, it sinks at once to what we call "politics." This was the first thought in looking over the Signal Service offices here, and is a key to the unselfish care and accuracy of all that is done.

Perhaps no better way of indicating the extraordinary nature of the Bureau will be than to explain that while waiting for Lieut. Finley's arrival, some ladies called at his office to inquire if the time was propitious for setting out on a journey to England. We were amazed at this, and still further, when the chief officer, without the least reserve, advised them respecting the circumstances, just as he would the latitude and longitude of the course. "There is," said he, "a storm passing over the North American Lakes. It is now at Chicago, where the wind is moving at thirty miles an hour. It will be at New York tomorrow, and cross the Atlantic in about three days. You can cross the Atlantic in the tail of this storm without discomfort, or you can wait for similar circumstances later on, of which you can be advised." This was, in substance, what was said, and when thought over, together with the vast commerce moving around the coasts of the continent, depending more and more upon information furnished by the Bureau, one can realize the practical and commercial value of the observations.

Seated at tables are telegraph operators in direct and continuous communication with stations all over the United States. The slightest change in barometrical pressure, temperature, force and course of winds is at once known and recorded in charts, on which isothermal and other lines of averages are drawn, The whole country, from Puget Sound to Maine and Florida, is in a sense under the eye of the observer, or rather it is as though he were present in all parts of the country at the same time.

On the roof of the building is mounted the "first movers," so to speak. Here are äerometers to show the strength of the wind; vanes to indicate its course; barometers to measure the pressure; thermometers to record temperature; gauges to measure rainfall; apparatus to record sunshine, and also humidity; but the strangest part of all is the extraordinary means employed in transmitting and recording these functions, which in most cases are traced in the form of diagrams on paper moved by clock work, and divided into spaces for time, intensity and so on. This is done, as most other things are at this day, by electricity. The readings from the roof of the Phelan Building are, in a sense, the same as those from Omaha or Boston, except the local data must be collected and made up, while that from distant stations comes in the form of a code of sums and averages, ready for entry on the charts.

The results are graphically laid out, manifolded or printed in the offices, to be forwarded to Washington, and are given out here wherever they have value or interest. General conclusions from the data are given to the press, and appear each morning, as all know.

Nearly all storms move from the west to the east, and the San Francisco station, with its branches to the northwest, thus becomes the initial one in respect to the whole country. It was the importance of this station, and in view of important meteorological generalizations commenced by Lieut. Finley some years ago, that has led to his being stationed here permanently, or at least until his projected work is completed. He is now preparing to move his apparatus and offices to the top of the new Mills Building, where the circumstances are more favorable for conducting observations.

BOATING IN SAN FRANCISCO BAY.

Accidents with sail boats on the Bay of San Francisco indicate, in most cases, an enormous stupidity on the part of those who own, hire and operate them. This stupidity consists in great degree from a supposition that anyone who has had some experience on the water can manage a sail boat here. This is a mistake. The faculty required, even where circumstances are favorable, is inborn, and not learned. It is that of holding constant attention on the management of a boat. The best sailors, that is, those who can sail a boat best, are just as likely to meet with an accident as a tyro if they lack the faculty of constant watching.

One can detect, in a few minute's observation, the man or boy who will capsize a boat. The safe one is oblivious to all but his sails and tiller, he takes no part in conversation. If a steamer passes he scarcely sees it. His running tackle is all free at his feet, no "kinks" in it; he is taciturn and sour — don't hear jokes, and only glances away from his charge to observe squalls on the water. When the boat is struck by a puff or squall he has "luffed" to meet it, or the sheet rope runs out unobserved.

The dangerous man, who is often a good sailor or one experienced in ship matters, engages in conversation. He points out places of interest, and is "one of a party;" managing his part as though it was a commonplace amusement, and turns the keel of his boat up to the sun.

People who have the faculty of watching a boat commonly know it themselves, but not always. To be caught a time or two is apt to warn one there is something wrong with their sailing faculty, and they have no right to take others out in a boat and endanger their lives. When one is to go out in a boat, the problem is not so much as to whether the person in charge is a sailor as it is, have they the "sailing faculty."

It requires years to learn the bay around San Francisco, not so much the water as the wind, which is torn up by promontories, cliffs and cañons. It may blow in almost opposite directions within a distance of 100 yards. At certain hours, and with certain weather symptoms, it is safe to go one place, and not safe in another. The currents too, are a patch work, following tortuous channels impinging here and there with vast whirlpools on one or both sides. There is no constancy in these currents. They vary with the height of the tide, the volume of water coming from the rivers, the wind, and sometimes without any discernable cause whatever.

The height of waves and their violence depends on whether the wind is with or against the currents, also on the pendulous or vibrating motion caused by obstructing spits, buried rocks, or velocity. Every few hours all this is changed, so that it becomes the work of years to "learn the bay," as it is called.

The best boats for practical purposes here are small ones, strongly built, not more than twenty feet long, that can be sailed by one man. The cat boat, or plunger rig, is best, because a gib "bags" in the wind like a lug sail, and will not fall off when struck by a squall, besides two sheet ropes cannot be safely handled in a small boat. All running gear should be free beyond possibility of mistake, and for summer the amount of canvas should be at least a third less than for winter, and half as much as can be carried where there is a low shore line and steady wind, as on the Atlantic Coast.

A gaff sail is preferable for one reason. It yields at the peak, and is that far elastic, but on the other hand must have less area, because there is more of the spread above, or the sail is higher. The triangular, or "leg of mutton," sail is, perhaps, best of all, especially if there is a short metal gaff, of twelve inches or so in length, that will, by its gravity, bring a sail down quickly when the halyard is let go.

In respect to provision against danger, it is not safe to carry ballast not counter-balanced by buoys of some kind, in other words, no boat should sink if capsized. This should be a rule in all cases, and boats should have an open rail around the gunwale so that if capsized there will be a means of hanging on. One can stick there toes into or under a deck rail, and then lay over a capsized boat, but cannot hang to a slippery bottom with their hands alone.

Another safeguard in sailing small boats is an elastic sheet rope. This, so far as known, is an invention of the writer, and is almost complete security against squalls, besides permitting a boat to work much better in rough water. It consists in placing in the sheet rope a spring of India rubber, or coiled wire, which is better, that will extend from two to three feet under all the sail will stand. The effect of one of these sheet springs is marvelous, a boat handles in a totally different manner. The comfort and ease of handling is quite enough to warrant the use of the device on all pleasure boats, while the safety from capsizing by squalls is almost insured.

The true boat for San Francisco Bay is a Swedish one, developed by thousands of year's experience under the same conditions that exist here, that is, bluff headlands, broken winds and squalls. They are queer looking crafts, and would be refused entry in the clubs here, because of their unsymmetrical appearance and general uncouthness. They are commonly about two and a half "beams" in length, of oak and lapstrake built, so as to give great strength. The typical Swedish boat is fastened with wooden pins, and nearly all parts are varnished with Stockholm tar, a kind of pitch resembling rosin, and very suitable for the purposes. Dutch galliots are sometimes finished in the same manner. The main peculiarity of a Swedish boat is its capacity for handling. The keel, which is very deep, is commonly no larger than the beam of the boat—is, in fact, a centerboard — and the effect is that a boat, when runnning free, can be turned completely around in a circle twice the boat's length in diameter.

The most daring races to be seen anywhere are the "Whitehall" regattas in San Francisco Bay. These are sailed in small row boats called Whitehall boats, generally before the trade winds, running free, with sprit sails. If a boat capsizes she is righted, baled out and goes on again. It is a dangerous amusement for any but expert watermen.

LABOR COST OF COMMODITIES.

Dr. Raymond has, in the *Engineering and Mining Journal*, been presenting some very able articles dealing with what may be called the ethics of labor and wages, and thereby, we fear, is wasting laudable effort in so far as any practical reform, or the amelioration of existing circumstances. It is a bold charge to make, but, as a matter of fact, not one in twenty, at this day, considers the legal or moral equities in the case, nor indeed for anything connected therewith, except the promotion of what they conceive to be their own interests. There are no premises for people to consider from, because the value of work is not known, and the rate of wages is regarded as a matter of accident.

This we say in no disparagement of Dr. Raymond's views, and the manner of presenting them, but only to point out that interests, and a sense of justness, must be set up in the contest. The most practical, and as we contend, almost the only feasible method of dealing with the disaffected labor of our day, is to, by every possible means, ascertain and publish the labor cost of commodities of all kinds, in other words, arrive at the real value of what men do, and then throw the responsibility on them ; do away with time hiring in all possible cases, leaving labor to stand on its own foundation and show for itself.

It is true that, in this and other countries, there is the impediment of changing prices, due to the obstruction of commerce and markets, but even this might be, and has to some extent been, provided for. Wages now vary in a wonderful degree, but it will be found on investigation they keep very close to product, in fact must do so by the fundamental laws of trade.

The three components of production, that is material, labor and expense, must be nearly the same everywhere, otherwise there could be no such thing as neutral markets or universal trade. Wages may be high in one country; where material and expenses are cheap, or low in another country where material and expenses are dear ; but these components must balance in order to produce saleable commodities in the world's market. When the relative cost or price of these components is known, then the mystery of wages will disappear, and no workman of any sense will demand more than his share, or strike because he thinks the profits of capital are greater than they should be.

What can be expected so long as the labor cost of commodities is not known, and is indeed concealed? Workmen assume unfair dealing with them, and their employer is not in a position to show the contrary. The facts are wanting, and this leads to suspicion and erroneous opinions on the part of workmen, resulting in strikes, union compacts, and assumptions that are not only unjust but impracticable.

We have, in these pages, pointed out, a good many times, how the labor in works could be set off by itself and made responsible, not only this, have explained how this is done successfully in some cases. The idea is not a chimerical one, but only common sense and just to all concerned. The method must come sooner or later, because labor must be dealt with by reason, and that sense of fairness which all men admit. Force will not do, its time is past. In the words of Carlyle "The true epic of our time is not arms and the man, but tools and the man." Substituting "reason" for "tools" in the above, and we have a true statement of the circumstances of our time. and we have faith enough in workmen to believe that not one in twenty would demand wages not produced by their work, or to be taken from that part which, by justice belongs to an honest employer.

As industry is now carried on, except in a few cases, workmen have no means of knowing what their labor produces, or what it is worth to those who employ them, and naturally set an exaggerated estimate of value on their services. What we need is evidence to show the truth, or error of this assumption; such evidence must come from learning the labor cost of commodities.

DECADENCE OF STEAM ENGINES.

Periodically we are treated to a homily on the decadence of the steam engine. Decadence is a popular theme, not only for steam engines, but other established things, and if one will notice, in this day of progress, there is nothing useful passes out of use. Prognostications in respect to steam engines are not confined to the unthinking, or the unskilled, on the contrary have been "figured out" scientifically, so to speak, but all such conjecture has the narrow premises of a difference in the cost of heat generated from different kinds of fuel.

At this time, because gas engines and vapor engines are comparatively a recent invention, the price of their fuel has not adjusted itself to that of the steam engine. They are all heat engines divided into two classes, internal and external combustion engines. One using a finer and more concentrated form of fuel, because burned in the cylinders ; the other using coarse fuel, burned under a boiler separate from the cylinders.

The result will, most likely, be that these finer kinds of fuel, such as gas, petroleum oils, and its products, will rise in price to the same level as coal, or in proportion to the heat they contain or will give out. They should, in fact, rise to a higher price, and doubtless will, because of certain conveniences of transportation, use for power, and other purposes. The coarse fuel engine, the steam engine, will no doubt continue to fill its place so long as we depend upon heat engines for power.

There is warrant for such an assumption in the remarkable improvements made in steam engines during twenty years past, and which, for anything now seen, are to go on. The horse power per pound of coal per hour is plainly in sight, and if attained, will, perhaps, mark the limitations of the steam engine, in so far as the cost of power derived in that manner, but there are other considerations, such as internal lubrication, or internal working without lubrication, and low temperature, that will favor the steam method, even if its economy is, in a degree, surpassed.

POLITICS AND TRADE.

This Journal has nothing to do with what is called "politics," except as the "art" that passes by that name is obtruded into the industrial and commercial interests of the country, a function which we have always contended does not belong to the Government further than the protection of property and personal rights therein. We have also contended and believe that whatever is undesirable and bad in our civil service is the direct result of its being concerned in and interfering with prices, values and trade, or in other words, with private interests.

Departments of our public service not connected with trade, are pure, efficient and an honor to the Nation, but just as soon as any function of the Government is directed to "person" instead of "people," then begins that system of disorder, discontent and corruption which is found in all countries in the same proportion that their governments interfere with personal and private affairs by the enactment of special and sumptuary laws.

We are now on this Coast experiencing some of the effects of disturbance in prices and the affairs of commerce. Had our trade been let alone, without petty bickerings with British Columbia, Chili, Australia and Hawaii, we would now be enjoying a full measure of business and thrift, especially if the Government, instead of its meddling policy abroad, had spent the same energy in protecting our rights at home against the rapacity of transportation companies by land and water.

The economy of commerce is obscure, and so hedged about with personal interests that it is nearly impossible to secure impartial regulations of any kind that relate to it, and the nearest approach to wholesome legislation is that which lets commerce alone. This is our creed, applicable alike to strikes of workmen, coin with a legal value, imposts, subsidies, government loans or government "anything," that interferes with personal rights and the fundamental laws of economics. These will go on and assert themselves in the end, irrespective of Congressional enactments. This is the doctrine of personal rights and justice between man and man, founded also on the claim that there is no knowledge of the industrial interests of the country that can enable useful legislation, a matter proved by the fact that idleness, disorder and poverty do not diminish, as what we call civilization, increases.

In the progress of science and industrial art, one sees men pursuing constantly a search after "truth." Turning to politics we find just the opposite, either a dread or disregard of truth ; so much so that a serial publication or book that attempts to deal impartially with "facts" is not read and not wanted. This sets up a line of difference that shuts out the best class of people from political offices and breeds a contempt for all parties, on the part of those most worthy to administer the legislative and executive functions of government.

HYDRAULIC POWER DISTRIBUTION.

It is possible that, in a good many cases, where the water power of streams is to be transmitted, that water itself is the best medium to employ. Prof. Unwin, in his late address before the British Association, explained that in both Zurich and Geneva, Switzerland, there are extensive systems of power distribution by pumped water.

The following extract is from his remarks, sums of money being converted from pounds to dollars :

"In 1871, soon after the completion of the earlier system of low-pressure water supply, Col. Turrettini applied to the municipal council to place a pressure engine on the town mains for driving the factory of the Society for Manufacturing Physical Instruments. The plan proved so convenient that nine years after, in 1880, there were in Geneva 111 water motors supplied from the low-pressure mains, using 34,000,000 cubic feet of water annually, and paying to the municipality nearly $10,000 a year. The cost of the power was not low. It was charged at a rate equivalent to from $180 to $240 per horse power per year of 3,000 working hours. But even the high price did not prevent the use of power so conveniently obtainable.

Since then a high-pressure water service has been established, the water being pumped by turbines in the Rhone. From this high-pressure service power is supplied more cheaply. On the high-pressure system the cost of the power is about 1½ cents per horse power per hour, or $40 per horse power for 3,000 working hours.

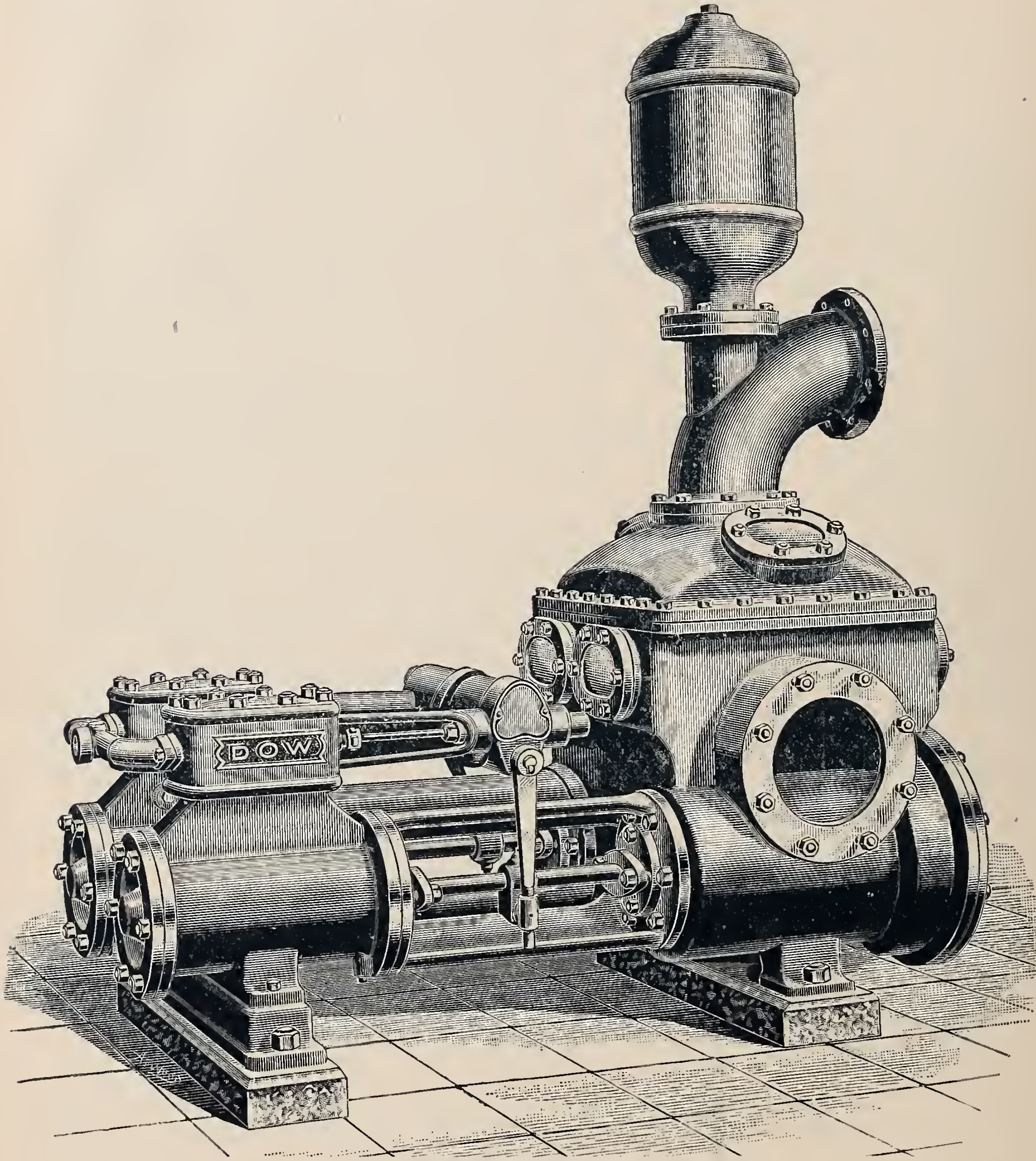
In 1889 the annual income from water sold for power purposes on the low-pressure system was $10,425, and on the high-pressure system $22,500. On the high-pressure system the receipts in 1889 were increasing at the rate of $4,400 per year.

In 1889 the motive power distributed on the high-pressure system alone amounted to 1,500,000 horse power hours, there being 79 motors of an aggregate working power of 1,279 horses.

In Zurich there is a quite similar system and power, amounting to 9,000,000 horse power hours in the year, distributed hydraulically to various customers, who pay a rental of $6,000 per annum. It will be noted that all this power in Geneva and Zurich is obtained from water which has been pumped, and it is the low cost of the water power that does the pumping which makes this possible.

But, further, in both Geneva and Zurich the whole of the dynamos supplying electric light are also driven by turbines using pumped water. The convenience of this arises in this way. The fall obtainable in the river in both cases is a small one, and varies. Large turbines are required, and these cannot work at a constant speed. Further, it is expensive to use these large low-pressure turbines to drive directly dynamos which only work with a considerable load for a short portion of the day. The low-pressure turbines in the river are, therefore, used to pump water to a high-level reservoir, and they work with a constant load all the 24 hours.

From the high-level reservoir water is taken as power is required to drive the dynamos, and the turbines driving the dynamos are small high-pressure turbines, working always on a constant fall at a regular speed, and easily adjusted by a governor to a varying load. The system seems a roundabout one, but it is perfectly rational, effective and economical."



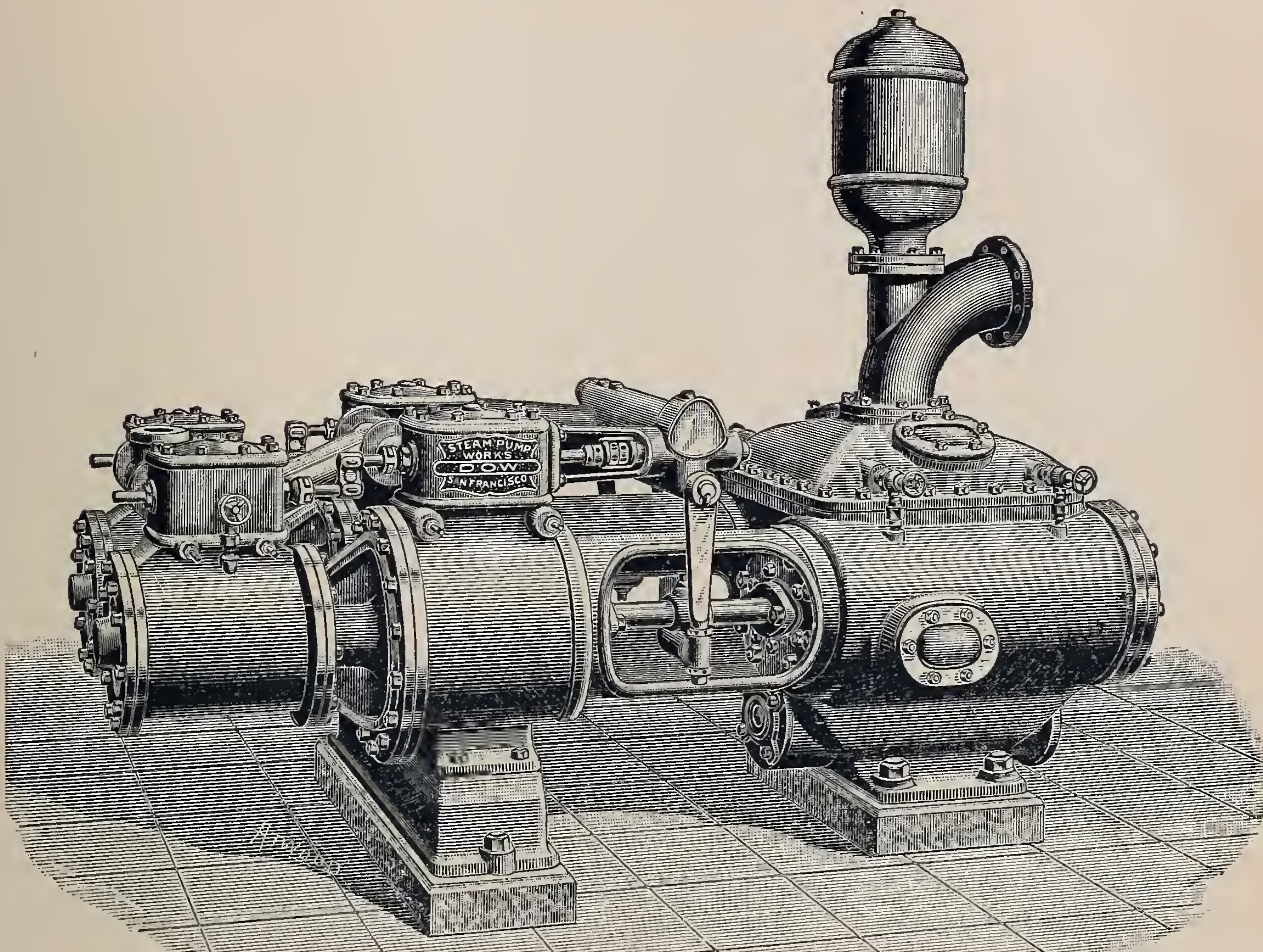
DUPLEX PUMPING ENGINE.

DOW STEAM PUMP WORKS, SAN FRANCISCO.

PUMPING ENGINES.

The pumping engines, illustrated on the present and next pages, show new and modified designs of the Dow pumps. The valve-actuating gearing has been simplified, and housed in, so as to be protected, and to avoid finished parts, which are always undesirable about water pumps, or the engines to operate them.

A recent visit to the works disclosed a system of implements and special tools unusual on this Coast, and rendered possible by a tolerably systematic manufacture. It is typical of what might be done



COMPOUND DUPLEX PUMPING ENGINE.

DOW STEAM PUMP WORKS, SAN FRANCISCO.

in any or all branches here if there was a market wide enough to permit uniformity, or some measure of uniformity. The circumstance called up some thoughts of the very strained conditions under which both our manufactures and commerce are laboring on this Coast, and which we comment upon elsewhere in the present number. Here it will be proper to say that in any line of manufactures wherein even a modified degree of uniformity of product is possible, will be found a corresponding tendency to those organized methods prevailing in the Eastern States.

We also notice, in the Dow Works, some modification of Eastern machine tools arranged according to instructions given here, that the makers will do well to follow in future for all implements of the kind. Makers of machine tools have learned a good deal from this Coast, in the way of having their work pulled to pieces in legitimate use. Cutting is done here in all the various operations at a more rapid rate. The class of work done, and the higher rate of wages, demands this, and it is done accordingly.

THE STATE UNIVERSITY.

If it is not presumptuous to offer a suggestion respecting the California State University, we will point out that to meet the requirements, uses, and ideal of the people of the State, the trend of education there should be strongly toward the natural sciences. We well know the prejudice, that exists among what are called scholarly people, toward everything exact, and we are uncharitable enough to ascribe such prejudices to an inability on their part to cope with and understand anything so inflexible as mathematics and the formulæ of science.

The last ten years has brought about a great change in the status of the sciences in respect to what is called learning, and much to the surprise of the inexact or ideal school, technical literature has come forward to a first place, clothed itself in a garb as polished and complete as any in the world, and has not only trenched upon, but actually occupied a place in the domain of letters ; has also allied itself with the physical, mental, moral and social environment of people in a degree that promises in the near future to relegate classic learning to the position of an accomplishment, rather than a branch of modern education. In selecting a President of the University, therefore, no matter what his learning may be in other branches, the more the better, but first and essentially he should be a scientific man, not a dabbler in "pure science" so called, but qualified in the exact sciences in so far as their mathematical basis, if not application.

The arguments that have been heretofore directed against utilitarianism must be abandoned at this day. The useful and exact cannot be set off from the ideal, they are the parts of a whole, with the realistic predominating, because on that must rest and depend life, health, and means of enjoyment.

There is also to be considered the popular view of the objects and aims of education in a State University. No policy should or can long exist contrary to what is expected and provided for. A portion of the people, a small portion, desire that the curriculum should include the classics and what we call polite learning. The great majority attach more importance to studies entering more nearly into the practical affairs of life.

The paper of Mr. Stetefeldt, presented elsewhere in this issue, also the discussion thereon, in which Professors Marks and Smith, of Stanford University, took a part, indicates the trend of opinion on the views we are trying to present.

RAILWAY TERMS.

It is a duty of everyone writing upon technical matters to keep their terminology within some bounds of relevancy. Our names are bad enough at best, and many of them, translated by our own standards, are nonsense. Among these are many railway terms : "smoke stack," for example. What has a chimney, the true name, or smoke pipe even, to do with a "stack ?" Why "stack" in any case ? Then again "track," meaning "way," or, as the English say, "permanent way." "Track" is shorter, but means something else, as stack does. A track is an imprint of the foot, or a mark left by something that has past along, but is not two iron rails, or a "railway." "Railroad" is another. There is no "road" in the case, that is something else. "Way" is the true term, a good old name ; "veg" in German, short and relevant, hence railway.

A "station" is a depot, and a "depot" is a station. We hear of freight "station," and passenger "depot." It is easy to understand that these names are reversed. Anyone can see that. "Car" is a slangy contraction of carriage, applied alike to passenger carriages and freight wagons. There is no objection to the name perhaps, but it sounds slangy to a foreigner who is learning our language. There are "frogs," "switches," and "cowcatcher," with a lot more of such names, as unnecessary as they are irrelevant.

It is very difficult to account for the use of irrelevant names, when the true ones are shorter and in every way better. We have had some experience in assisting to translate such terms into other languages, and remember the perturbation of a Swede, who once found a "dog" among American implements ; also a bridge to "carry" certain tons to the span. "But," said he, "the bridge does not move ;" sustain was substituted, and all was clear. "Wrench" caused a fruitless search in the dictionary, where it is only a verb. "Key" settled that case. "Drill" for a drilling machine, and "planer" for planing machine, was made clear, but could not account for a lathe not being called a "turner," which would be a parallel.

There is a commercial bearing in this matter, as well as an etomological one, and as the "tendency" is always to wrong names, it is, as before said, a duty of everyone, as far as possible, to avoid slangy terms which have only a local meaning, and which usually belong somewhere else and apply to other objects.

EXTRACTS FROM A NOTEBOOK.

[BY "TECHNO."]

No. XVIII

A STUBBORN PEOPLE —— FRANCS AND FLORINS —— HOLLAND TAKEN BY THE DUTCH —— A RATIONAL BATTLE —— EMIGRANTS NEED NOT APPLY.

——————We made our way from Lübeck to Rotterdam, which, in many respects, is the principal "dam" in the Netherlands. How many there are no one can tell. The word is synonymous with our word "dam," and means a water barrage in a river or estuary. Rotterdam is at the mouth of the Rhine, or mouths of the Rhine as one may say, because it splits up like our Mississippi River. Rotterdam is a kind of commercial outpost of Germany, a place of landing goods for the Empire, and the wonder is that this Dutch country has not been somehow merged into the German Confederation—then again perhaps not, when we come to read of the stiff-necked nature of these people, who have never been subjugated after an infinite amount of trying by great powers, notably Spain in the wars of Philip II.

It is curious to think of, and to know, the energy and indomitable spirit that has, in the past, characterized these people of Holland, or the "hollow land," meaning also Netherlands, or "Nederlands," the lower lands. The name is relevant, very much so, because a great deal of it is lower than the sea. In fact, a great deal of it *is* sea "pumped out," as my Uncle says. Haarlem Meer, or the Sea of Harlem, was pumped out forty or fifty years ago. A portion of the Zuyder Zee (Cider Sea) has been recently pumped out, and in both cases a county or so gained. These pumping appliances of Holland are wonderful, both in number and extent, always of extreme simplicity and efficiency, and this is the principal engineering work of our day in Holland.

In times past this country was a center of the mechanic arts. Peter the Great came here to learn ship building, and some industries have lasted until now, but none that require much power. Some of my Uncle's views here will be in place, and better than my own, at least more comprehensive. I have a note as follows:

"Holland," said he, "is the queerest country in the world, or at least that part of the world we know. Somethings about it are unpleasant. It is a trading country, very rich, and the main business is to increase the number of florins. If you want to be 'skinned,' as we say at home, here is a good chance. We are staying at the 'Bible Hotel.' Just wait until the bill comes, no bible in that, but florins for this and florins for that. This insidious coin is worth forty cents, or a little more, just double the franc. Two hours from here, in Belgium, a franc will buy just as much as a florin does here. There are discounts, percentages and 'shaves' of one kind or another for the stranger in every transaction. They have no coal here, and live by percentage, and thrive on it too.

Then too, there is the cleanliness of which we hear so much. It is true, but not an inherent virtue. It is a forced one, a struggle for existences. Keep clean or die is the rule. How do you suppose they sewer a city like this, for example? I will show you before we go away how they go "up" out of their houses to dump garbage into the sewers. It is scrub or die, as I said before.

The domestic or home economy of this country is the best in the world, and their external economy selfish — that of a trading community. Their management of Java is of the same kind we apply to lemons when compounding punch. They have famous tobacco and long pipes, and the care of these pipes is the first duty of the men here. I have seen a smith's striker with a long pipe, who divided his attention between the sledge and the pipe, with a large difference in favor of the latter.

The whole thing can be summed up by saying that modern Holland has learned enough to draw the main part of their living from their neighbors. Those that do work, work faithfully, and have to. It is like the cleanliness. When fighting the sea and abominable weather there is no chance of shirking. They build some steamers here for pure contrariness. They also had the audacity to make compound engines, good ones too, forty years before the British began it. They are the stubbornest people in the world, and don't want anyone to agree with them. Washington Irving's 'Knickerbocker History' is no fancy picture of the Dutch at New York. If not true it ought to be, and I am afraid is the best picture of Dutch natural traits we have. They were never conquered. Romans, Northmen, Spaniards, and the rest who have tried it, soon looked up easier work ; now there is little chance of it.

No nation except the Dutch could keep the water out of here. It has taken a thousand years to learn how, and never could have been done by any other people less stubborn. There is no timber, no iron, coal or other elements of manufacture here, unless we count wind and water. The former answers in a way for power, and water is of little use on a dead level, but there is cheese and gin manufactured, and that reminds me of a toddy which must straightway be compounded."

Out of this medley one may select a good many points "annent" Holland, as the Scotch say. There are many more, and I am fully prepared to believe the story of the Dutch judge, who decided a case between two merchants by "weighing" their account books, and finding them "equal," ruled that the books "balanced," and that the sheriff must pay the costs of the suit for bothering the court with such a case. It was the last case brought before that judge, no one even ventured into that court again. The court had peace, so did the people, and Solomon was excelled. I also think of the Dutch general who marched his forces against the Swedes who settled on the Delaware in our early times, and who, on arriving in front of the Swedish fort, found that his army was "out of beer." A truce was called while this beer matter was settled. The Dutch went into the fort with the Swedes, and after a time, when the canteens were replenished, and the two commanders were ready for battle, they found it impossible to separate the armies. They had become hopelessly confused by exchanging hats and otherwise, so that when the two sides were drawn up neither dared to fire for fear of killing friends on the other side. The dispute was then settled amicably by the generals, with no other aid than common sense and their pipes. It was the best campaign to be found in the history of the whole world, the only one that comports with common sense.

There are no spread-eagle fireworks and jingoism in Holland. That went out with Old Van Tromp's broom, which he hoisted at his masthead and sailed up and down the English Channel with, after "sweeping" out all opposing craft about there. The Dutch are educated beyond war, unless it would be to keep savages out of their country. There is no spirit of smashing someone for "glory," and in that lies a civilization beyond any other country at this day.

There is no need of immigration laws here. "The Dutch have taken Holland" is an old saying, which admits of the qualification that no one else wants Holland, and no one else wants to go there. I imagine that no land is so free from "foreigners." Nature always provides some kind of compensating clause in her economy. A salubrious country, without great heat or cold, is overrun with strangers seeking climate, emigrants flock there, and are usually not a desirable class. They are the high and low. The industrial middle class, who own and manage business, do not emigrate, they have business at home. It is the speculative, the vicious, and undesirable generally, that form a great part of emigrating people. They do not go to Holland, and never will. They cannot cope with the Dutch in any way, would be beaten at every turn, and starve, if they did not freeze or drown.

——————One of the wonders of this country is "willow mattresses," not to sleep on, but to hold mud, and build up permanent works, which there is no other material for. The plodding Dutchmen, while smoking, are always thinking and observing. They discovered centuries ago that Nature, in her grand schemes, had not neglected their country, but employed osier twigs and roots in embankments to retain water. When the Rhine is to be dammed or dyked, willow mattresses are sunk and mud piled on top, then harder material. The great dykes are made in the same manner, so are the common roads where they cross wet or reclaimed land. A row of mattresses is laid along, mud on top, then dry earth if any, and on top of all a good hard covering of shells, stone, asphalt, or something to withstand wear; when done there is both a road and a dyke; not only these but a continuous wharf. The ditches at the side, where the mud is scooped out, become a canal, used for all the common purposes that our wagons are; so we have a fine road, a water dyke, and a wharf all made at once, and not like our public works, with an eye to the next contractor, but there to stay for generations to come.

Schools are perfect — education everywhere, charitable institutions the wonder of the world, peace, quietnesss and stubborness. If I were a Dutchman I would live here, if not a Dutchman would not think of such a thing. "The Dutch have taken Holland." As Rip Van Winkle says, "May they live long and prosper."

——————From here we go by Flushing to England again, where sundry pages of my note book, filled up long ago, will find some place in these notes.

(To be Continued.)

VERTICAL TRIPLE-EXPANSION ENGINE.

GEO. S. STRONG, M. E., NEW YORK.

Mr. Strong, as many of our readers will know, has, during some years past, contributed a good deal to the advancement of steam machinery, and has succeeded in interpreting, or as we may say, anticipating the tendencies of modern machine design. The engine, shown in the plate opposite, considered in respect to its operating features, arrangement and appearance, will be a subject of interest to our readers. The symmetry of the structure, as a whole, is attained by employing two single-acting, low-pressure cylinders, with the initial and intermediate ones set on top of these. The low-pressure cylinders, by this arrangement, perform three separate functions, as power cylinders, as guides, dispensing with crossheads, and, as an integral portion of the engine framing, to support the other two cylinders ; also covering a considerable portion of the range of the connecting rods.

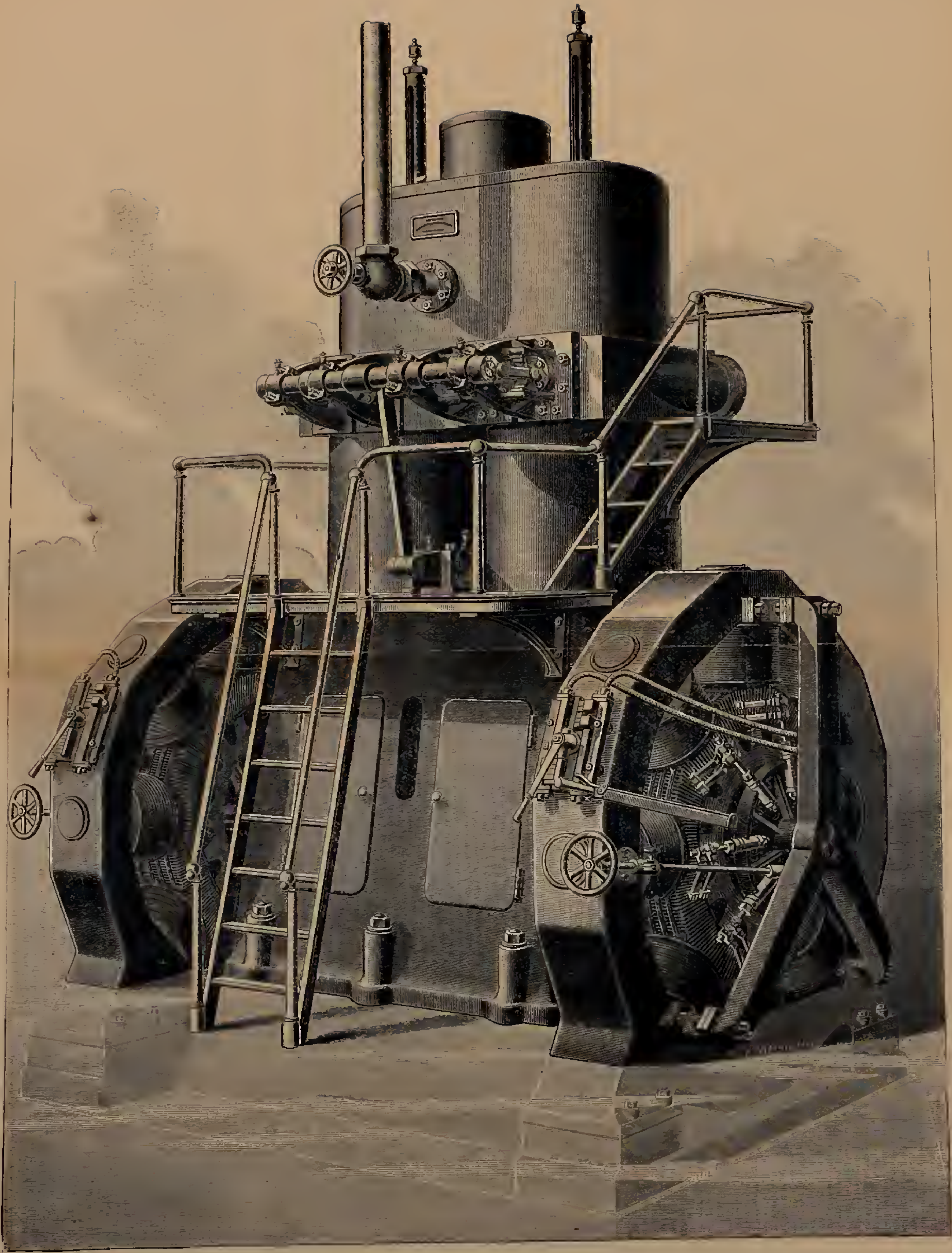
This arrangement of the engine lowers the height of the whole structure a distance equal to the stroke, length of the crosshead and stuffing box, and clearances, amounting to at least one third of the whole height, or in other words, the superimposed cylinders add nothing to the height as compared to a common steeple frame engine. This is an important matter in a high-speed engine of the kind, attained here without infracting any rule of good practice.

The engine is shown connected to dynamos at each side, but it will be understood that there is nothing special in the arrangement for this duty, and that flywheels or pulleys can be applied at one or both sides of the engine in the usual manner.

In a description, accompanying the drawing, Mr. Strong says :

" An effort has been made to put a triple-expansion engine into the simplest and most compact form, and at the same time to meet all the requirements that are considered necessary for general efficiency and economy. A peculiarity of the design is that the engine is self contained and balanced. The reciprocating parts of the two sides have simultaneous opposite movements, the cranks being 180 degrees apart, and thus in a manner balancing each other. In consequence of this, and the fact that each side is independently balanced by a counter weight on the crank, less foundation is required, and quiet running secured.

To meet the requirements of an engine using steam of 180 to 200 pounds pressure, piston valves have been selected for the high and



TRIPLE EXPANSION DIRECT CONNECTED ENGINE.

GEO. S. STRONG, M. E., NEW YORK.

intermediate cylinders, and gridiron slide valves for the low-pressure cylinders. By this means frictionless valves for the high and intermediate cylinders, where the pressure is high, are secured. In those cylinders the matter of clearance is comparatively unimportant. In the low-pressure cylinders, however, small clearances are very necessary for economy, and are brought about by the use of the gridiron valves in the cylinder heads.

The piston valve of the high-pressure cylinder is actuated by a block sliding in the well-known Fink link, so designed as to give a perfectly equal lap and lead, and at the same time equal cut-offs at both ends of the cylinder. The position of this block, and therefore the cut-off, is controlled by a sensitive high-speed governor, the resistance to the movement of which is very slight.

The exhaust of the high-pressure cylinder, and the admission and exhaust of the intermediate cylinder, are controlled by a connection to a fixed point at one end of the link. These valves have a fixed travel, and point of cut-off. The movements of the low-pressure valves, both inlet and exhaust, are produced by the same connection to the Fink link, and are such that when these valves are unbalanced they are motionless. All valve motions are derived from a single eccentric in the center of the crank shaft, in direct line with the piston valves between the two first cylinders. All pins and bushings in the valve gear are of hardened steel, thus reducing the wear and rendering replacement easy.

The governor is provided with a safety device, so arranged that in case the governor belt breaks, the arms of the governor will be elevated, and the link block thrown to an extreme position, thus cutting off the supply of steam and bringing the engine to a stop.

The crank shaft is forged from a solid steel ingot, and the counterweights are bolted on. The pedestals are bored, and turned on their bases to fit a bored seat in the bed plate or frame of the engine, to which they are secured by fitted bolts. The seats for these pedestals are bored by a single setting of a boring bar, and are consequently in perfect alignment.

Two sizes of the engine are made as shown in the drawing, one being 150 horse power, and the other of 250 horse power. The first runs at a speed of 300 revolutions per minute, and the second at 225. It is the intention of the makers to furnish engines of this type up to 2,500 horse power.

The engine described is the invention of George S. Strong, of 45 Broadway, New York, and is made by the Providence Steam Engine Co., Providence, R. I. The details were worked out under the supervision of Mr. F. W. Dean, of Boston, Massachusetts."

THE "EXAMINER" BUREAU OF PATENTS.

We have been favored with a batch of circulars from the *Examiner* Claim Office at Washington, and among much other wonderful matter find, in one of the circulars, the following statement in respect to patents and inventions :

"Inventiveness is a disease which, after the first attack, "becomes chronic. The man to whom an agency has rendered "satisfactory service in securing a patent is usually a client of that "agency for life."

There is much more, including a list of fees, among which is one of $100 for "mechanical engineering service" when required ; $30 for filing a caveat ; and $5 for sending a copyright to the Librarian of Congress, which costs ten cents or less.

A competent patent agent here is presumed to be a mechanical engineer, and to give such professional advice as he can to clients without a fee of $100, or any other sum.

The first clause, quoted above, indicates very fully the class of clients who employ the *Examiner* Bureau to transact patent business. Our experience shows that, in this City, not one applicant in twenty is a chronic inventor, or anything of the kind. Nearly all patent applications are to protect manufactures carried on by the applicant, or in his interest, and are not pursued for speculative purposes.

The mania for inventing, here referred to, is commonly confined to the unskilled and incapable, and invites the methods followed by a similar class of incapable patent agents, who send out circulars inviting business at low rates, and frequently at no rates to begin with, until the victim signs something or is in some way committed; then will come the real phase of the matter, and the exactions are pressed to the limit of credulence and endurence ; but even this is not the worst feature in such cases, because the specification is apt to be defective and incomplete.

Any competent patent agent knows the difficulty of preparing specifications and drawings, when there is free consultation with the inventor, or even when the practical application of his invention can be examined. This makes it impossible to have business satisfactorily done by a "Bureau" at Washington, and when people at a distance are compelled to send cases for preparation, they should select old, reliable practitioners who do not conduct what is called a "grist mill patent business."

THE TECHNICAL SOCIETY.

The regular meeting of this Association was held on the 7th of October, at their rooms 815 Market Street.

The following new members were elected:

F. H. Carsson, Civil Engineer..................San Francisco, Cal.
Homer Perry, Mechanical Engineer..............San Francisco, Cal.

"The Committee, appointed on July 1st, to draught a memorial to the memory of the late Andrew Fraser, of this City, and a member, of this Society, submitted the following:

The removal from our midst of an active member, in the prime of life, endowed with high attainments and personal qualities of every commendable kind, is an event that demands our solemn consideration, and condolence with those more nearly connected in a personal way with our lost member.

That such a life as his, richly stored with the useful and good — a work of fifty years to build up — should be destroyed in an instant by an assassin's hand, with no incentive but a few paltry dollars on his person, is a sad commentary on the uncertainty of life and the inefficiency of safeguards to protect it.

The Chairman of your Committee, who was intimately connected with Mr. Fraser, and, more than any other member of this Society, has felt his loss, and can best bear witness to his many good qualities, is glad of this opportunity to join in a tribute to his memory.

Mr. Fraser's career has been one of activity and usefulness. It is familiar to our members and needs no recital here. Your Committee is merely to put into words the sentiments of the Technical Society of the Pacific Coast respecting their lost member and associate, and to offer condolence and sympathy with his many friends, who will be interested in knowing his standard and relations here. This we have briefly done in such form as our feelings have dictated, and as is here submitted."

R. S. MOORE,
L. C. RUSSELL,
E. A. RIX.

Upon motion the report of the Committee was received, placed on file, and a copy thereof ordered to be sent to the family of the deceased member.

Mr. C. A. Stetefeldt then read an interesting paper entitled "Curriculum of a Modern College; Classics *versus* Natural Sciences" relating in particular the conditions existing at the old German Gymnasium, a portion of which, with the discussion thereon, is reprinted in another place.

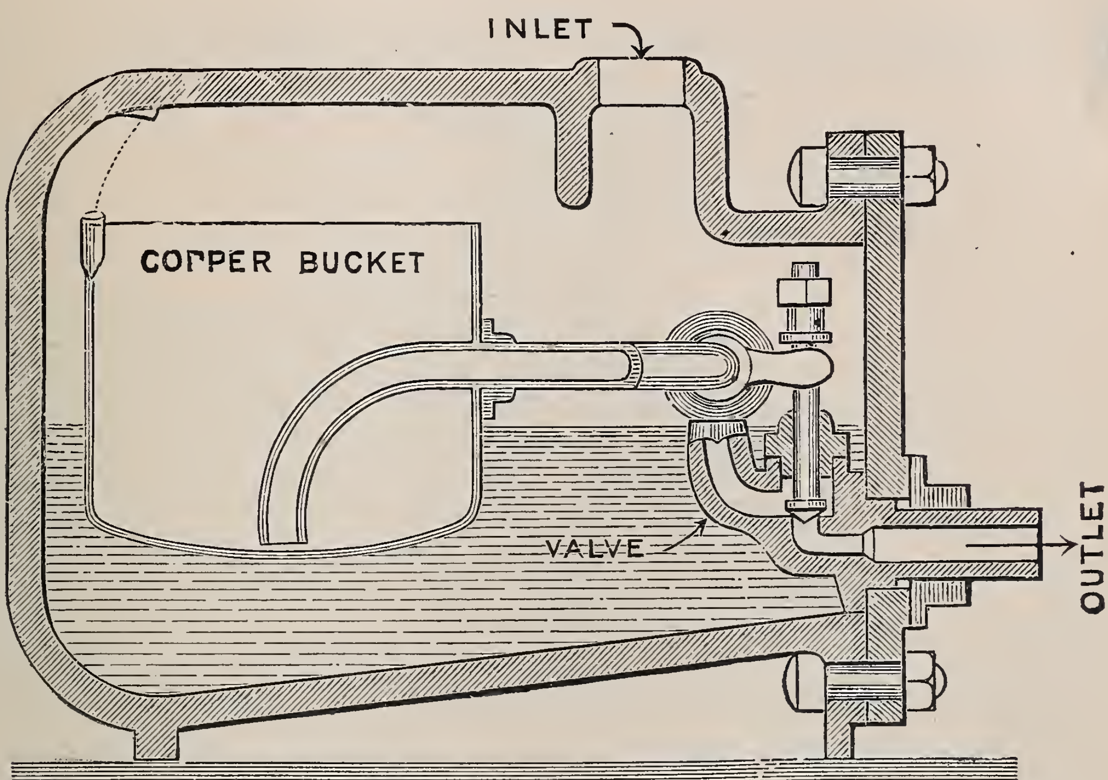
At the next regular meeting, on Friday, Nov. 4th, Lieut. J. P. Finley, chief officer of the U. S. Signal Service on this Coast, will address the Society on "Climatic Features of the Pacific Slope, and their Relation to Atmospheric Conditions over the Plateau Regions." The meeting will commence at 8 P. M., and as this will, no doubt, be the last regular paper of the season, a full attendance is expected.

SMOKE CONSUMING.

A committee of the Engineer's Club in St. Louis sent out inquiries to seventy-eight firms and companies, using bituminous coal for fuel, asking their experience with smoke consuming apparatus, and in the answers is found a very discouraging indication of failure. Only seven of all were employing any kind of smoke preventing devices. Nineteen had tried and discarded them, and only one out of the whole number was satisfied with results, and he, no doubt, because the apparatus used was of his own invention. This report which we propose to further consider at more length in the future, is the most reliable literature on the subject that can be referred to, in so far as the use of Illinois coal, which includes Chicago, where there has recently been so many vaunted discoveries of smoke preventing apparatus. The fact is, that for thirty years past the progress made is not much, in this country at least. In England, where smoke making is an indictable nuisance, the circumstances are much the same.

The main causes of failure are not inherent, but circumstantial. No system of firing that entails more labor and must be left to the discretion of a fireman, will ever succeed. It is true that in perhaps the greater number of failures the immediate reason has been injury to boilers or the destruction of furnace irons, but these come in the same category with increased work and care on the part of firemen.

In more than one half the cases, perhaps two thirds, of the whole, counting by number, one man attends to the fires, the engine and connected machinery, and whether his work is easy or hard, he cannot be expected to give that care to firing which will prevent smoke. In a case we knew of in England, some years ago, the proprietors of a works found themselves "summoned" at irregular intervals before a magistrate for "making smoke." The suits being in a sense friendly, the fines imposed were light, and the firm thought of the expedient of making the firemen pay them. This stopped the smoke effectually.



NEW STEAM TRAP.

Mr. J. C. Winans, the agent in this City, sends the above drawing, showing a section through a new steam trap, which, he claims, has especial merits. The drawing indicates the construction so clearly that description is unnecessary. The operation is thus described in printed matter sent with the drawing :

" The operation of the trap is as follows : as the chamber fills with water, the bucket floats and rises until it strikes against the top of the chamber and can go no further, the water continues to rise until it flows over and fills the bucket, causing it to sink to the bottom of the chamber ; the weight of bucket is such, that by this operation the valve is opened, the water in chamber above the top of bucket and the water in bucket is then discharged, the bucket then rises until it floats again and discharge valve is closed. The valve is so arranged that a body of water is always left above the valve seat after each discharge, consequently steam cannot escape because it cannot be forced through the water. The amount of water delivered at each discharge depends on the size of the trap chamber."

The time required to discharge the traps is set down at from five to twelve seconds for the different sizes when the steam pressure is eighty pounds per inch.

HEIGHT AND POSITION OF MOUNT ST. ELIAS.*

By Mark Brickell Kerr,

Member Tech. Soc., National Geographic Society, and A. I. M. E.

[Topographer of the Expedition of 1890.]

DISCUSSION OF RESULTS.

A little over one hundred and fifty years ago Mt. St. Elias was discovered and named by Bering, the great voyager and explorer. Since then many navigators have observed the peak, and calculated an approximate height and position, with varying results. Many experienced mountaineers have endeavored to ascend and occupy the summit, but the storm king gathered his forces and rushed down in anger upon such daring invasions, and in a short time the huge uplifted giant was again left alone, unconquered and uncrowned.

Clouds and mist envelop the peak almost constantly, but occasionally the veil is raised, and the awed spectator is allowed a glimpse of its hidden beauty, between the passing and repassing of bright halos and skurrying, changing snowy banners. Will it be possible to measure the correct height without again attempting to ascend it is asked by the student in geography? A better approximation can of course be obtained. But to set at rest the discrepancies raised by earlier measurements, great care must be used to eliminate errors that are bound to creep in, where refraction and kindred elements are such unknown quantities, especially uncertain and serious in a trigonometric survey.

The writer, as topographer of the expedition of 1890, has collected considerable data, and in this paper will present technical points, touched upon only lightly in articles hertofore written. These thoughts should prove of much interest at this time, for the uncertainty existing in measurements made by former explorers has influenced the U. S. Coast and Geodetic Survey to fit out another expedition, which will soon return from this region. Messrs. McGrath and Turner, who so ably conducted a similar expedition up the Yukon River to determine astronomic points on the 141st meridian for future boundary reference, have been placed in charge. They are completely equipped with instruments needed for a

*Read before the Technical Society of the Pacific Coast, Sept. 2d, 1892. Reprinted by permission

SKETCH MAP OF MOUNT ST. ELIAS REGION, ALASKA

By

Mark B. Kerr.

Western part from maps by H.W. Seton-Karr and W.H. Topham.

Coast line from U.S. Coast Survey.

Reproduced from National Geographic Magazine
by permission of U.S. Geological Survey.

detailed survey, and will obtain many sets of observations more accurate and satisfactory than the hasty, and necessary preliminary, reconnoissances of the past few years. They will probably redetermine the geographic position of the station at Port Mulgrave, from which point the observations of 1874 were taken, and, if the weather permits, will sight St. Elias and other points from as many different stations as possible, thus endeavoring to eliminate errors which a lack of reciprocal angles is likely to cause.

This expedition will also make a more detailed topographic map of the coast line, establishing points of extreme accuracy by trigonometric survey. Upon this chart, data for the south-east boundary between Alaska and British Northwest Territory, will be laid down. It is hoped that the weather will remain clear enough for them to obtain a number of observations upon the principal peaks ; for without a check upon the work, the great distances between which observations are taken must lessen the value to be attached to the result, as it will probably be impossible to allow the time needed to ascend and occupy the principal peaks, and thus close the triangles.

Mt. St. Elias, lying so close to the intersection of the 141st meridian, with the theoretic line running northerly along the supposed continuous mountain crest from Portland Channel to the intersection with said meridian, is therefore not only an interesting but a very important factor in such a determination of boundaries. According to the terms of the treaty, between Great Britain, Russia and the United States, the boundary, after leaving Portland Channel, "should follow the windings of the mountain range, parallel to the "coast, until the 141st meridian is reached, and from thence north-"ward along this meridian to the Arctic Ocean. Should the moun-"tains be found more than ten marine leagues from the coast, then "the limits of the boundary shall be formed by a line parallel "to the windings of the coast, which shall never exceed the distance "of ten marine leagues therefrom." The distance between Mt. St. Elias and the nearest point of the coast (near Icy Bay) is about 33 statute miles, so that Mt. St. Elias is very near being the point where this theoretic boundary from the south meets the 141st meridian.*

This agreement as to boundary was drawn up from information laid down upon Vancouver's chart, which represented a regular and continuous range of coast mountains. Recent observations have disproved this theory, and shown the mountains to be not only broken

*Goldthwaite's Geographical Magazine, January 1891, page 67, Report of Expedition of 1890.

and irregular, but between the St. Elias and the Fairweather Ranges the ground becomes rolling and completely cut through by the Alseck River, which Mr. E. J. Glave and Jack Dalton, his companion, so fearlessly descended by canoe and by raft, over rapids, falls and the many difficulties and dangers of an unknown, barren and unexplored country.*

Besides the importance of the subject in the boundary question, the height and position of St. Elias is of much popular interest, and scientists and the general public are anxious to see it scaled, and all doubt set at rest concerning the true height. The various measurements are tabulated below as follows :

HEIGHT AND POSITION OF MT. ST. ELIAS.†

Date.	Authority.	Height.	Latitude.	Longitude.
1786	La Perouse	12,672 ft.	60° 15′ 00″	140° 10′ 00″
1791	Malaspina	17,851 "	60° 17′ 35″	140° 52′ 17″
1794	Vancouver		60° 22′ 30″	140° 39′ 00″
1847	Russian Hydrographic chart 1378.....................	17,850 "	60° 21′ 00″	141° 00′ 00″
1847	Tebenkoff (notes)	16,938 "	60° 22′ 36″	140° 54′ 00″
1849	Tebenkoff, Chart VII......	16,938 "	60° 21′ 30″	140° 54′ 00″
	Bach. Can. Inseln..........	16,758 "	60° 17′ 30″	140° 51′ 00″
1872	English Adm., Chart 2172..	14,970 "	60° 21′ 00″	141° 00′ 00″
1874	U. S. Coast Survey.........	19,500±500 ft.	60° 20′ 45″	141° 00′ 12″
1890‡	Nat. Geographic Society and U. S. Geological Survey..	15,350 ft.	60° 12′ 00″	140° 46′ 00″
1891	Nat. Geographic Society and U. S. Geological Survey..	18,100±100 ft.	60° 17′ 51″	140° 55′ 30″

In discussing the above results, the first point to be considered is the method used in taking the observations and means to counteract refraction, an element which throws so much doubt upon trigonometric determinations of heights where the sides of the open triangles are so long, and where conditions are so utterly distinct and

*See Frank Leslies' Weekly (various sketches during 1891).
†Tabulated by Dr. W. H. Dall, except 1890 and 1891.
‡First Report, approximate. Second Report, 16,700 feet.

different between a station at sea level and a station on the summit of a great peak.

Referring to the work of 1874, we find that Dr. W. H. Dall in an able and exhaustive discussion, places the height at 19,500±500 feet, *i. e.* the probable error is 500 feet. Looking over this result carefully, we cannot but admire the intricate astronomic calculation through which a result is obtained from such meagre data and also from the uncommon method used. The position is fixed by horizontal angles connected with Azimuth line at Port Mulgrave, and by Azimuth observations taken directly to the peak from a point at sea, the position of which was determined by sextant.

In the discussion of this data we read as follows concerning the classes of vertical angles for elevation.*

"The first of these comprise sextant angles. Except under favorable circumstances and especially unless within a short distance of the object measured I do not consider these of any great value. The uncertainties of position and refraction are so great as to render the result in most cases of only the most general character."

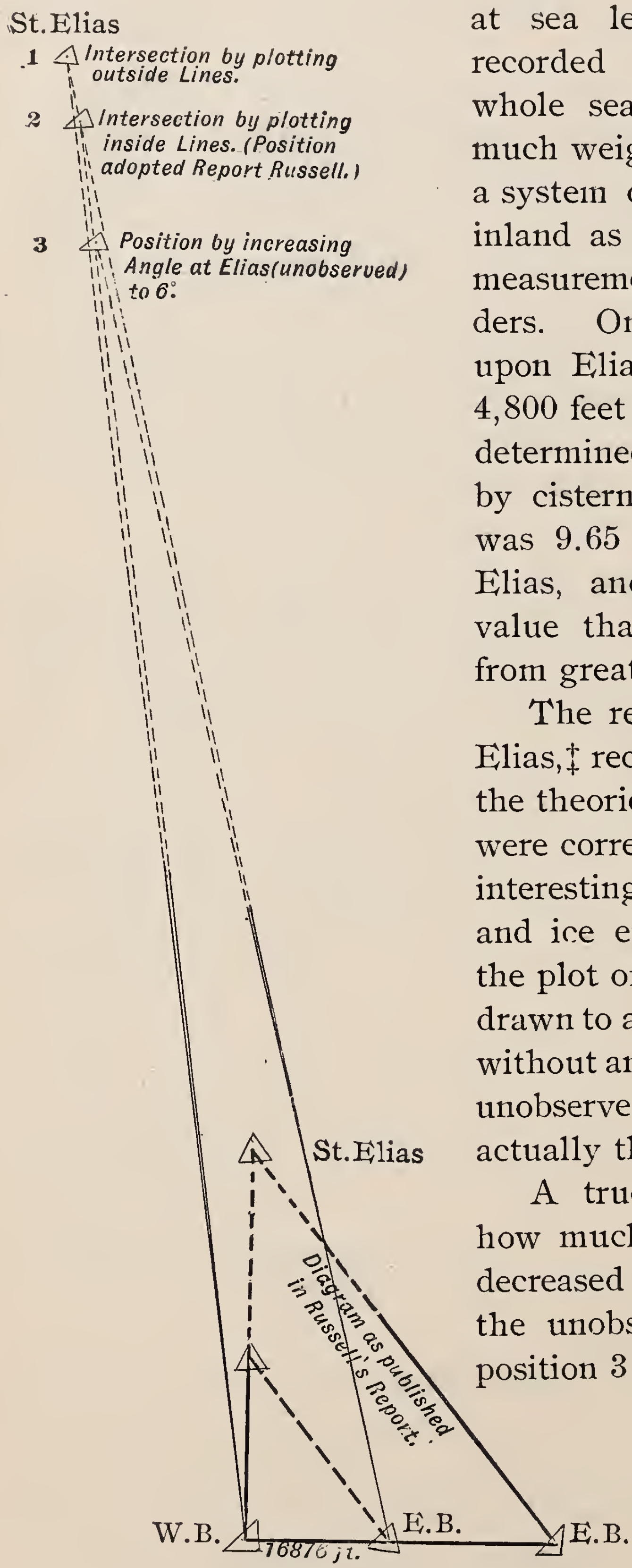
Looking over this result and realizing that one point only of observation is on land and the other end far out at sea, and these two points not intervisible, we are led to conclude, notwithstanding the unobserved angle being nearly 60 degrees, that the limit of error given here is too small, and that a closer approximation to the truth would be ±1500 feet.

Data from which observations previous to 1874 were obtained is not available, and it is therefore impossible to refer to it. Results must be taken without question, the authorities mentioned being responsible, but as the vertical angle taken by Malaspina in 1791 agrees closely with that of 1874, and the general topography delineated in the former chart is also comparatively reliable, we would attach more weight to the result of Malaspina than to any of the other earlier measurements.

Had the scheme of work of 1890† been carried out as intended, the result of that season would have had more weight than any other, but the loss of the transit instrument made recourse to a less accurate one necessary, and many stations were interpolated by the three point problem. However, all meander stations were cut in from secondary stations. The checks obtained by vertical back angles as well as cistern barometer observations referred to a base station

*See report of Superintendent of U. S. Coast Survey for 1875. Appendix 10.

†See National Geographic Magazine, Vol. 3, Page 195. Report of Mark B. Kerr.



Scale 6 miles = 1 inch.

at sea level where readings were recorded regularly throughout the whole season, would naturally give much weight to the result. And again a system of triangulation was carried inland as far as possible, and surface measurements made to check meanders. One measurement for height upon Elias, was made from a station 4,800 feet above sea level, the latter determined both by angulation and by cistern barometer.* This station was 9.65 miles distant from Mt. St. Elias, and would give much more value than other observations taken from greater distances.†

The report upon the height of St. Elias,‡ recently published, proves that the theories of the expedition of 1890, were correct, and adds many new and interesting facts concerning glaciers and ice erosion. In the first place, the plot of the triangulation not being drawn to any scale gives an impression, without an inspection, of a much larger unobserved angle at St. Elias than is actually the case.

A true plot of this figure shows how much the horizontal distance is decreased by even a slight increase in the unobserved angle at Elias (see position 3 in diagram). Now plot the greatest and the least readings of the Azimuth circle, intersect these lines from the ends of the base and combine this difference in position with the probable error ± one minute noted in readings

*See Goldthwaite's Geographical Magazine, Vol. 1, Page 67.
†The two measurements of height of station differed by only 44 feet.
‡See National Geographic Magazine, Vol. 3, Pages 231—237. Report of I. C. Russell.

of the vertical arc. The result shows at once a much greater probable error in elevation than 100 feet, and consequent error in position (see positions 1 and 2 in diagram). To prove this more clearly the reader is referred to two tables, as follows:

I. Being resulting angles and computation of distances obtained from work of 1891.

II. Being computations of the height of Elias from three positions already referred to which show a range as follows:

West Base from 16,438 feet to 18,926 feet.

East Base from 16,462 feet to 18,940 feet.

Taking these results into account, as well as the great distance of the base stations from the peak, the different temperatures, atmospheric changes, and uncertainty of refraction, we are led to the conclusion at once that the possible error of 100 feet is too small.

If the base could have been extended by triangulation to two convenient points and the elevations actually determined both by cistern barometer and reciprocal angles, a coëfficient of refraction could have been obtained, and observations taken closer to the peak, as well as Azimuth observations from the two ends of the base, but this was not down, unfortunately.

The computation also of the geographic position of Mt. St. Elias, using the Azimuth and angle of elevation obtained at Port Mulgrave by the U. S. Coast and Geodetic Survey in 1874, combined with elevation obtained by the expedition of 1891, is open to much criticism as a crude and unreliable method, and very little weight can be given to the result.

It is not my intention to enter into further discussion of the uncertainty of trigonometric measurements for heights where distances between stations are so great, and especially so when it is impossible to obtain reciprocal zenith distances or at least a series of observations on different days.

In my own experience in topographic surveying in California and the West, I have had to throw out vertical angles very often when horizontal distances were much over 12 miles, simply because the atmosphere and relative refraction were so different at the two stations. In this case we were then forced to depend on cistern barometer observations, taking corrections for relative humidity. This was found to be entirely satisfactory, and I am sure most topographers will bear me out in this statement. So in discussing the results from which these various measurements have been obtained, we must consider also the great difference of elevation and

TABLE I.

RESULTING ANGLES.*

WESTERN BASE.				EASTERN BASE.			
	Right Vernier.	Left Vernier.	Corrected Vertical Angle.		Right Vernier.	Left Vernier.	Corrected Vert. Angle.
1	98° 31′	98° 32′	+5° 43′	1	76° 07′	76° 08′	+5° 37′
2	98 32	98 30	+5 43	2	76 07	76 07	+5 37
3	98 29	98 29	+5 43	3	76 06	76 07	+5 37
4	98 29	98 28	+5 43	4	76 07	76 08	+5 37
5	98 29	98 27	+5 43	5	76 07		+5 37
6	98 30	98 30	+5 43	6	76 07	76 08	+5 37
7	98 30		+5 43	7	76 07		
8	98 25	98 27	+5 43				
	98° 29′ 22″	98° 29′ 00″			76° 6′ 51″	76° 07′ 36″	
Mean	98° 29′ 12″		+5° 43′		76° 07′ 10″		+5° 37′

COMPUTATION OF DISTANCES.*

Distance East Base — West Base = 16,876 feet.

Station.	Angle.	Computation in feet. Log.
St. Elias........	5° 23′ 38″	A. C. Log. Sine................= 1.026 862
West Base......	98 29 12	Log. Sine...............= 9.995 218
East Base	76 07 10	Log. Sine. ....= 9.987 129
		Log. Distance, E. B.—W. B..... 4.227 270
		St. Elias—West Base..........= 5.241 261
		St. Elias—East Base...........= 5.249 350

* National Geographic Magazine, Vol. III, pp. 234, 235—Report of I. C. Russell

TABLE II.

COMPUTATION OF HEIGHT FROM THREE POSITIONS.

Western Base.	1 = 34.50 miles.	2 = 33.01 miles.	3 = 30.10 miles.
Log. Dist. Elias—W. B. (in feet)......	5.260 453	5.241 280	5.201 200
Log. Tan. Angle of Elev. = +5° 43'..	9.000 465	9.000 465	9.000 465
Log. Difference of Elevation..........	4.260 918	4.241 745	4.201 665
Difference of Elevation...............	18,235 ft.	17,448 ft.	15,910 ft.
*Correction, Curvature, and Refraction	+ 681 "	+ 623 "	+ 518 "
West Base above Sea..................	+ 10 "	+ 10 "	+ 10 "
	18,926 ft.	18,081 ft.	16,438 ft.

Eastern Base.	1 = 35.10 miles.	2 = 33.63 miles.	3 = 30.65 miles.
Log. Dist. Elias—E. B. (in feet).......	5.267 941	5.249 361	5.209 064
Log. Tan. Angle of Elev. = +5° 37'..	8.992 750	8.992 750	8.992 750
Log. Difference of Elevation..........	4.260 691	4.242 111	4.201 814
Difference in Elevation...............	18,226 ft.	17,462 ft.	15,915 ft.
*Correction, Curvature, and Refraction	+ 704 "	+ 646 "	+ 537 "
East Base above Sea..................	+ 10 "	+ 10 "	+ 10 "
	18,940 ft.	18,118 ft.	16,462 ft.

conditions existing between the stations, and must realize that "the increase of temperature with altitude causes an unusually rapid decrease of density in the atmosphere with a corresponding increase in refraction, thus producing the mirage so common here. It is noticeable only when both the observer and object are in the cold layer. A ray of light may reach the observer after following a horizontal path or after raising slightly, then being refracted down again. The result is to make the object appear stretched out and give it increased height."†

* 4-7 sq. distance in miles.
†Report on Muir Glacier, by Prof. Harry Fielding Reid, National Geographic Magazine.

Summing up all the data available and proofs at hand we are thus led to believe that the preponderance of evidence points to the highest elevation recorded as being too great, and the lowest as being underestimated.

A mean of all the observations taken upon St. Elias gives a result of 16,693 feet, and the writer is inclined to the belief that its true elevation, when determined, will not vary much from this mean.

The rocks of the St. Elias region all indicate a recent origin. The only fossils found were upon the western crest of the Pinnacle Pass Hills, about 20 miles from St. Elias, and at an elevation of 5,000 feet above the sea. They were identified by Prof. I. C. Russell* as Mollusca. A few fossil plants from the same locality were afterward identified by Prof. Lester F. Ward, as Salix-California, and are found in the auriferous deposits of the Sierra Nevada. The subsidiary ranges are of shale and sandstone, and we saw crystallized rocks only upon the summits of the range.

No indication whatever of volcanic activity was noted, but one day as we saw an immense cloud of dust arise as the avalanches of ice and rock rushed down the slope of St. Elias, Cook, and Augusta, we could readily imagine how observers from great distances had mistaken this for the smoke from a volcano.

A great many observations have been made and articles written on the effect upon the system of rarefied air. In the summer of 1886 I camped six days and nights upon the summit of Mt. Shasta, part of the time alone and in a snow storm. The only trouble I experienced was a decrease in power of exertion, physical capacity, and shortness of breath. I had a poor appetite the whole time, and a little nausea, but I think the air from the sulphuretted hydrogen springs near by had more to do with my inconvenience than the altitude.

At Mt. St. Elias we were one month continuously upon glaciers at various heights. Once only were we troubled, and that with snow blindness. We were climbing up an ice fall where the huge detached ice masses were separated by deep crevasses. The blue goggles cast such a heavy shadow as to render our jumping over these crevasses rather precarious. As they were numerous, broken, and irregular, we took off our glasses, and that evening had a severe attack of snow blindness, and we nursed our eyes for twenty-four hours.

*Geologist in charge of expedition of 1890 and 1891.

At the Equator, it is stated, that high elevations produce amiability and entirely remove combativeness. It seems to me that this spirit or temperament changes with the latitude, for the bump of combativeness was strongly developed in our small party, which increases proportionally I should say, from the equator northward, as the square of the distance.

Extended field topographic work was stopped by a snow storm. After many days of travel over the ice, crossing crevasses by narrow and precarious bridges of snow, climbing up ice falls, roped together to prevent slipping, we had reached a glacial lake where the old icy bottom of deep azure gave a beautiful tint to the water. The elevation was 8,000 feet above the sea. We decided to leave our tent here and make a rush for the peak.

Very early on the morning of August 22d, 1890, we started and made the first thousand feet in a little over an hour. Crevasses did not interfere with us and we made rapid progress over the surface of the frozen snow. Our aim was to reach the divide between Newton and St. Elias, camp there over night, and then make a rush for the summit.

We were then beneath the first precipice of St. Elias. The rock was steep and bare and we could readily identify its nature. The summits of this great range are of schist, which conclusion we had already reached, having found specimens amongst the debris brought down by the glaciers to the sea.

At this point of our ascent the snow began to fall. Thinking it best to await a clear day for observation upon the summit, we cached our instruments near the cliff and between two huge crevasses, and returned to our lower camp.

We made ourselves as comfortable as four men could, crowded into a 7 × 7 tent, out upon a glacier in a snow storm and with short rations. I awoke quite early, and was surprised to find the snow had drifted, almost covering our tent, and found that 2½ to 3 feet had fallen on a level during the night, and the storm still raged.

On account of short rations we determined to descend to a lower camp and make a new start, but storm succeeded storm, and although two desperate efforts were made, we never succeeded in again reaching our cache beneath the divide. I was caught upon the glacier during one of these storms, and passed three anxious days and nights alone, without fire and without blankets, with only a rubber blanket for shelter, until relieved by my companions.

"SQUARING A CIRCLE."

In the *Compass* for August 1892, we read of a mathematical work, the "Papyrus Rhind," now in the British Museum, written in Egypt about 2,000 B. C., or nearly 4,000 years ago, in which there is a rule saying that "the diameter of a circle, shortened by one ninth of itself, gives the side of an equal square." Quoting further in respect to the "seven problems" of the Athenian school, one of which was "squaring a circle," as it is called, we are told that:

"Pythagoras was probably the first to solve one of the problems. He doubled the square, and as a result of that discovery we have the 47th Prop. of Euclid. One record states that a pupil of Aristotle named Sextus was commissioned to convey the secret of squaring the circle to Archimedes, who at that time was the leading mathematician in applied geometry.

This secret consisted in the knowledge of a certain line found in every circle. This line was called the 'Nicomedian Line' and is mentioned in the Categories of Aristotle's Organon. During more than 2,000 years this mystic line has eluded the search of a host of mathematicians. The most remarkable fact connected with its rediscovery is the extreme simplicity of its construction, which makes one wonder that it was not recognized earlier.

Draw a diameter in any given circle, and a radius perpendicular to it. Through the middle point of this radius draw a chord from one extremity of the diameter. This chord is the side of a square equal in area to the plane of the given circle.

Making this line a standard measure for all geometric computations, it becomes a solving factor for all the polemic problems."

The above is a quotation to which the editor of the *Compass* says:

"Assuming now, the diameter of a circle to be 4, we then have the chord $= \frac{8}{\sqrt{5}}$, consequently the area of the circle $= \left(\frac{8}{\sqrt{5}}\right)^2 =$ 12.8. Now the area of a circle $= \frac{\text{diam.}^2 \times \pi}{4}$ whence $\pi = \frac{\text{area} \times 4}{\text{diam.}^2}$

$$= \frac{12.8 \times 4}{16} = 3.2$$

If only correct, how much simpler this value would be than the cumbersome old fashioned one of 3.14159 . . . which however has stood the test of centuries, and will continue to do so."

The strangest thing we have ever seen in this connection was a brass plate prepared by Professor Harvey, of Glasgow, so divided and fitted together that it could be arranged in a circle or a square. The plate was six inches in diameter and one quarter inch thick, and the joints were so carefully made that they were nearly invisible. It was based on the 3.2 theory above explained.

THE CLASSICS AND NATURAL SCIENCE AT A GERMAN GYMNASIUM*

By C. A. Stetefeldt, Mem. Tech. Soc.

We are unable, for want of space, to print more than an extract from Mr. Stetefeldt's lecture, which extract, however, with the discussion thereon, contains the gist of the subject treated upon.

The question may be asked: What part will the classics play in the education of future generations? A radical change cannot be expected in this generation, because the brains of "the powers that are" are too much befogged with the utility of the present system. Too many men are still living who foolishly glory in their having received a classical education, although they know only a few Latin and Greek vocables, and never could read the Iliad or the odes of Horace with fluency.

Students of classical schools, three hundred years ago, actually acquired the use of the old languages, and wrote and spoke Latin at least fluently. But at this day, from the ages of eight to eighteen or twenty, they are taught the syntax of Latin and Greek, but no language. How many men at the age of forty, who have graduated from a classical school, can translate a passage from Sophokles, or write a letter in Latin? All the profit we gain from this classical waste of time at college is that we know the meaning of scientific terms derived from Latin or Greek — with the aid of a lexicon; or as my friend Professor Hesse very pointedly puts it: "The principal advantage I derived from the study of Greek is that I know the letters of the Greek alphabet."

There was a time when the genius of man found expression almost exclusively in sculpture and poetry. His must be a dull mind, indeed, who looks upon the Apollon Belvedere, the Aphrodite of Melos, or the Aphrodite de Medici, and fails to realize that *here* the perfection of the sculptor's art had been reached, never to be surpassed or even equalled in ages to come. Less marked in excellence were the productions of poetry; but the grand epos of the blind poet, and the tragedies of Sophokles and Æschylos will be read so long as the human race exists. Also the philosophical and historical writings of the ancients were of a high order, and Aristoteles has been justly called the father of natural science.

*Read before the Technical Society of the Pacific Coast, August 7th, 1892. Reprinted by permission.

Then came a time when the classical ship was blown about on a rough sea, and finally foundered on the rock of Saint Peter. Now, men's minds were given only to religious thought, and in attempting to save their own souls and those of their neighbors, they succeeded admirably in creating a hell on earth. But when the Church of Rome gained immense power, and accumulated great wealth, the popes and the Roman prelates commenced to lead lives of luxury, pleasure, and vice, finding the discussion of religious dogmas insipid. This led to the Renaissance of art, poetry and literature. While the sculptures of even a Michael Angelo never approached the Greek ideal, the art of painting — of which the ancients had only known the rudiments — reached its zenith. Architecture had already, about two centuries prior to the culmination of the period of the Renaissance, reached its highest ideal, and the grandeur of the Christian religion had found expression in the Gothic Cathedral.

His must be a dull mind, indeed, who can behold the divine Madonnas of Raphael and Holbein at the Dresden gallery, and not acknowledge that *here* the genius of man has left productions, the perfection of which will never be surpassed by generations to come. The wife of the San Francisco millionaire was right, and she showed an intuitive appreciation of art, when she insisted that none but one of the *old masters* should paint the portrait of her beautiful daughter.

Then *again* came a time when men's minds became insane with religion. The paint on Raphael's canvases and frescoes, which adorned the Vatican, was still fresh when the Reformation threw the whole civized world into the turmoil of war, bloodshed, and torture. But one great boon was given to mankind—*the Liberty of Thought*—such as it was at the time; and a genius, born long ago in Greece, but thus far suppressed by Christian fanaticism, modestly raised his head — *Natural Science.*

The Church of Rome had found it expedient, in order to preserve its authority, not to permit the promulgation of ideas conflicting with the most absurd statements contained in the Bible. Natural science was considered the enemy of the Church, and its promulgation made a crime, punishable by execution at the stake. While the Protestant Church claimed liberty of thought for itself, it begrudged this boon to scientific men, who were, however, tolerated to a certain extent, but not encouraged. In matters of education, which was entirely controlled by the Church, Catholic or Protestant, the classics reigned supreme, and natural science played no part whatever. Education meant a classical education, and men of science used Latin exclusively in their publications. Hence, the use of Latin and Greek vocables, often a barbarous combination of the two languages, in scientific nomenclature, which custom prevails today, and will probably do so forever.

It would be unjust to find fault with the classical schools of the time to which I refer. The poetry and literature of the ancients, which, to this day, we acknowledge as our models, formed *then* the principal stock of information for educational purposes. Latin was then the language of the theologian, the philosopher, the scientist, and of all cultured people, just as French, in the past century, was the language of the diplomats, the courts, and of polite society all over Europe. You will recollect that even Alexander von Humboldt wrote a part of his works in French. It cannot be denied that the use of Latin by scientific men of all European countries was of considerable advantage.

In proportion as, in subsequent centuries, the power of the Church waned, and the supremacy of the State increased, education became more and more secular; and natural science, finding itself free from the irksome restrictions and persecutions of the Church, made progress with enormous strides.*

There *is* a time *now* when natural science reigns supreme, and throws in the shade art, poetry, literature, and everything else. At last we have *unrestricted Liberty of Thought.*

Thousands of busy brains are gathering and recording facts in all branches of science, which has differentiated in an embarrassing degree; but few are the master-minds able to form universal laws. We are all working to reach one great goal: To find *the One Law of Motion*, which governs the universe, life included.

Although the human brain is composed of many millions of cells, endowed with thousands of functions, its powers are finite in regard to the absorption and reproduction of ideas. Why, then, should a part of this priceless organ be all burnt out in early youth to a dead grammatical cinder by littering it with etymological compost? Why should youths, between the ages of eight and eighteen or twenty, be left to the mercy of hide-bound classical pedants, at a time when the brain grows and is most apt to receive impressions? Would it not be a blessing if all these gerund-grinders were shipped to the South Sea Islands, and there fed to the end of their

*It is not necessary here, for sake of the argument, to sketch in detail the progress of art, literature, and science from the time of the Reformation to the present; but if we ask: What is the greatest achievement of the human mind in modern times? The reply is—*Darwinism.*

natural lives on stewed Greek particles and broiled irregular verbs?*

Then, and *only* then, will we reach our goal; a master-mind will rise and formulate that *One Law of Motion* to which every atom of the universe responds, and which will be so simple that the average brain cannot fail to comprehend it.

DISCUSSION.

Professor Charles D. Marx.— "I must confess I was very much interested in the historical review which Mr. Stetefeldt gave us in his paper. I, myself, had the opportunity of testing at a somewhat later period the advancement which has been made in the curriculum of the German schools. It was my fortune in 1870 to attend a school in Germany where a great many of the defects he has cited as existing in the old system have been avoided. He speaks of the curriculum as then consisting mainly of the classics, this is true at the present time, but to a more limited extent. More stress is laid on modern lines of thought, and a good deal upon the study of mathematics and the study of natural sciences. It is interesting to notice that these are being recognized more and more in Germany. The Emperor (erratic as he may be considered) favors these lines of instruction, and he recognizes the fact that we ought to be living more in the present and less in the past.

Mr. Stetefeldt's review is interesting, and it must be valuable to us in this country. There are certain important lessons for every country to learn that has not a definite system of education, and it is but natural that they should turn to other countries which have well developed systems as their source of information.

We all probably recognize the fact that in the earlier development of American education it was customary to follow the system of education of other countries, especially of Germany. I think it is fully recognized at the present time, that the conditions here are somewhat different from those in the older countries, and that we must find our solution along our own lines. I believe that the system of education which we are working out at present in our own country, will ultimately lead to more satisfactory results.

In Germany it is almost a necessity that one should study the classical languages, because the only chance for preferment lies

*It is hardly necessary to state that I do not mean this literally. Men devoting themselves to scientific research should know the Greek alphabet, and they should be taught in their early youth sufficient Latin as a foundation for the easy acquirement of those modern languages, the roots of which are derived from Latin. Since scientific men have abandoned the Latin tongue as a means of exchanging ideas, it becomes necessary for them to be familiar with several of the modern languages.

along certain lines, and young men are compelled to study the classics in order to enter the professions. It is not possible for a man to study medicine at the University who has not completed his course at the Gymnasium. Of course, every man is anxious to have the largest choice of a profession at the time he decides to enter upon some career. Under these circumstances it is quite apparent why, in Germany, they pursue the study of the classical languages.

In this country we are more liberal, and it is not considered important for a civil engineer to be able to read Cicero or Virgil, I am free to say that our development is a much more rational one. I think that a little sentence which Dr. Jordan is often in the habit of quoting, expresses the present condition of the development of most of our American Universities: 'the air of liberty is abroad — it is blowing.'

I think most of us have seen the dangers which Mr. Stetefeldt has so clearly pointed out tonight, and that we are walking along the paths that he and others made for us so many years ago."

Mr. Stetefeldt.— "A great many years ago when this question of classics and natural science was discussed in Germany, the advocates of the classics went to work in a very ingenious way and got up statistics which showed that all the eminent men the country had produced had been at the Gymnasium. This was very stupid and very unfair, because if a man in Germany wants to occupy any prominent position, if he wants to go into the civil service of the Government, or desires to become a lawyer, a doctor or a professor he is forced to go to the Gymnasium — there is no other course left to him. Consequently the best talent went to the Gymnasium—not that the Gymnasium produced it."

Prof. Smith.— "I quite agree with what has been said. Of course the study of the classics has been urged as a factor in culture, and in the development of character, but I believe it is the attitude of professors of Latin and Greek in our best institutions that they do not want men to come into their classes unless they come of their own free will. I believe the most advanced men who are teaching Latin and Greek do not hold that these studies should be required in the college curriculum.

I am inclined to quote a little statement made by Professor Sweet to his class at Cornell University some years ago, where he was a teacher. 'The world will not pay you for what you know, but for what you are able to do.' A man may acquire all the wisdom of all the ages, and yet he may die and the world not miss him. But if he can make use of his knowledge and benefit mankind, the world is further along for it. This is a matter which needs to be considered by a young man in shaping his course.

I do not set up the study of the natural sciences as preëminent and above all other things; I believe every young man and woman who is preparing for a life of usefulness ought to be allowed to select that line of work which they prefer. So I believe that the elective system is the proper one, and that by and by there will be no opposition between different departments of study, and each person will pursue that line which they naturally prefer."

Dr. Behr.—"I perfectly agree with the views that have been so completely expressed by my friend Mr. Stetefeldt. I know very well that a great deal of valuable time is lost by the study of the classics. But there is a tendency of going too far and abolishing Latin altogether in our universities. Latin is the neutral ground where all nations meet. Scientific literature would require the study of a dozen languages, where now a knowledge of Latin is sufficient. Unfortunately, some of the sciences have outgrown the Latin, which would not have been the case if Latin had been allowed to grow with them. Of course, that cannot be remedied now; but I am very much in favor of keeping the Latin in all biological branches as long as possible, until in course of time it is replaced by a modern language that has taken universal sway.

George W. Dickie.—"I want to preface my remarks by saying that I believe in classical education for one reason; I think i all our professional men had to study the classics there would not so many of them get through. The sentiment of poetry and that sort of thing is being crushed out, and is not getting a fair chance. I go through dry specifications from morning until night, and I often wish just for the sake of variety some fellow would get up a specification in rhyme or blank verse. I think it would be a good thing for our architects and engineers, and people of this class, to go way back and gather up what they can find among the ancients. Now, when we get down to a scientific basis for anything, we get down to facts, and there are not enough facts to go round we need to indulge a little in imagination. The poetry is going out of our business. Straight lines and direct strains are getting to be monotonous. By all means let us have the classics—let us have it all. They are grinding out so many students, at these polytechnic schools and colleges for the study of the sciences, that we are overrun with them. I am glad I got into the business when they were studying the classics and nothing else. If they did then as they are doing now I would be very badly off.

The paper is very interesting indeed, although I think it is a little one-sided. We ought, by all means, to hold on to the classics, especially in engineering. I don't know how far back the ancient history of engineering goes, but we have reached a time when we look back at what they were doing fifty or sixty years ago in mechanical engineering, and it is ancient history, has a language of its own, a principle of its own, a shape of its own, and we have got out of it. If we could now put some imagination and poetry into what we make, we might sell it for ornament when otherwise it would not sell at all."

PROF. KEITH.—"Science has advanced so fast that it almost makes a language of its own. If we used Latin we would need a new lexicon, and, like Webster's dictionary, it would become an immense volume. While the studies of the ancient languages and the classics have their place, and should be open to those who desire to pursue them, science really develops faster than the language can advance. We coin and compound new words, which are set aside in a short time because too long to express the idea, and a new and briefer word is substituted. The idea goes with the word. Then why should we, in this age of rapid advancement, be held back by the necessity of expressing our ideas in a dead language?

It is the rubbing of one fact against another that produces a third, and if all had to be published in German, or in English, or French, or Latin, or Greek, we would find that those who originate these ideas, and who are making these advances in the arts and sciences, would not express them, because they do not wait for the information that has gone before — they start out in new lines of their own, and after the facts are discovered, the theory and the talk about it is to be performed. Modern papers are written in the language of those who have the idea, or who have experimented and brought out the facts, and published in the language with which they are familiar, and with which they can fully express what they wish to convey. To be sure, it is a hindrance to publish in different languages, but at the same time the ideas are preserved, and the translations are made and widely circulated. Most of those who study Latin in the schools do not remember it, and they are compelled to express themselves in the language with which they are familiar, and even then they find it necessary to continually add new words to properly express new discoveries and things connected with them."

LITERATURE.

Cassier's Magazine, No. 10.

AUGUST 1892.

The present number, which should have been noticed last month, is a continuance and improvement of the standard set up by this Magazine at the beginning. The illustrations, paper, type and make up are a marvel, when we consider that the subject matter is tarnished with the grime of industry, and the applied sciences, as our friends of the scholastic and classical school would say.

It must be an annoyance to those devotees of the inexact school that find in Greek and Latin the elements they call learning, to have serial literature of this class thrust "between the wind and their nobility." It is a reminder of the position into which their teachings, as a branch of modern education, must soon pass. It is like the besmirched Manchester school that rose up fifty years ago to confound the Tory nobility in England with a superior philosophy, and then, as if to add insult to their vanquished foes, held an art exhibition of paintings in that cotton-spinning town, which rivaled all but the collections of the Nation itself.

Professor Carpenter continues his writing on the technical schools of America, giving an account of the Purdue University, at La Fayette, Indiana. The drawings indicate a works rather than a laboratory, and when we consider how, thirty years ago, when we traversed the Wabash Valley, then devoted to pork, corn and ague, with a meager system of secular public schools, it is hard to realize the change that has called out such institutions as this.

Professor Carpenter neglects to give any of the "dimensions," but as the various divisions or departments are fitted up for a hundred or more students, there must be a wide capacity of the whole. It is a technical school, not an omnibus one where "things in general" are taught, and hence may succeed in what is almost sure to be a failure when technology is taught as a subordinate branch, with a score of other things.

Mr. Charles H. Werner writes a third article on "Direct Connected Engines," illustrated by typical examples, most of them, as in previous cases, showing the tendency to what is called the steeple-marine type. One exception is a "swash-plate" engine with roller bearings, that seems out of place in the collection.

Two examples are of engines, by Belliss & Co., of Birmingham, England, which recalls the circumstance of this firm, at a very early time in the art, setting out to found a manufacture, as it may be called, of small auxiliary engines. Some years ago, when we were at the works of Messrs. Belliss & Co., they inquired respecting a band saw for iron cutting. We asked respecting the kind of work the machine was to perform, and were astonished to find that the owners did not know. "We want the machine on general principles," said they. "Other firms of skill and standing in our line of business employ these machines, hence we know they are required here. The use will develop itself as we go on." This is not all the method, we are in this country apt to ascribe to English firms. It is progressive in the fullest sense.

It will not be a criticism of Mr. Werner's views to say that the design of directly-connected engines, as set forth in his examples, is by no means settled or symmetrical. He should include, and no doubt will, some of Mr. Strong's engines, if not too large for the class.

The North American Review, No. 431.

OCTOBER 1892.

The present number begins with a contribution on "Home Rule" by Mr. Gladstone, that, among his many essays, is by no means the best. It is wrong, as we believe, in being controversial, and in answer to an opponent, a noble one to be sure; but the Prime Minister of England can well ignore all argument on a theme which, as President Cleveland said, is "not a problem but a condition."

Besides Mr. Gladstone's methods of argument places him in a position of disadvantage. Truthful candor does not always avail in appeals made to popular opinion, especially in a foreign country, and, as we have seen in a previous case, his generalizations broad and universal can be answered by wily appeals to local prejudice. The Duke of Argyle is, by his environment and interests, no matter what his intellectual powers, compelled to argue from a different plane. We feel anxious that Mr. Gladstone write no more on any subject. The world has his measure, and it is full.

Governor Pennoyer, of Oregon, contributes an article on "Questions of the Campaign," in which we find one paragraph that contains a very severe criticism of the present method of raising the Federal revenue. The paragraph is as follows:

"It is to the eternal disgrace of the Federal Government that while its tariff taxation falls with grievous weight upon the laboring classes, there is no tax whatever upon the wealth of the country. This is probably the only civilized country in all Christendom that thus relieves wealth from sharing the burden of taxation. In our State governments wealth is taxed, and the sound theory prevails that a citizen should pay in proportion to the property he owns, but the taxation by the Federal Government is by impost duty upon articles of general use and consumption, and hence a poor laborer who supports a large family by the labor of his hands, is in reality taxed much more for the support of the Government than his rich neighbor worth a million of dollars, who is without family. The injustice of such a system of taxation is apparent."

The context, which we have no room to quote, adds further explanation, but the main point, here so vigorously presented, is the difference between National and State taxation. Governor Pennoyer, we infer from his article, does not belong to either of the dominant political parties.

Mr. Labouchere's article on the "Foreign Policy of England" shows a grasp of national relations and historical facts possible only to one who has made European diplomacy a life-long study as Labouchere has done, and who, besides this, is capable of understanding the nice distinctions that permit comments without offense.

This article will be more widely read than any other among a collection of unusual merit in the present number.

The Engineering Magazine.

OCTOBER 1892.

In the present issue, which should be, as we suppose, No. 25, "Shall the Professions be Regulated," by Mr. N. S. Shaler, argues that societies and guilds tend to the impairment of the "freedom of contract," hence should not have recognition in law. In fact the theme of the essay might be guild *versus* freedom of contract, and a good many readers conceding this antagonism will feel like calling the writer's attention to the fact that nearly the whole commercial, political and social economy of our time is in the same condition, an infraction of the freedom of contract.

Without entering further into the subject one is reminded of how many times this term has been applied to strikes of workmen, as in the present case, where Mr. Shaler instances the Homestead affairs as an infraction of the freedom contract, just as though there was such freedom in other cases.

The fact is that such freedom does not exist in the degree intimated, and scarcely in any degree at all if we apply such a rule as is here set up. There is scarcely a commodity, from a nail to an ocean steamer, that can be bought under free contract in half the countries of the world. A guild of workmen, or of professions, is but one form, and perhaps not the worst form, of interfering with contract, or trade and exchange, which is the same thing.

The article which will be most widely read and considered is one by James C. Bayles on the "Industrial Decadence of Germany," not that it indicates a very thorough acquaintance with German affairs, but rather the observations of a traveller or a visitor there. The conclusions are, however, indisputable. German industry is being subjected to and destroyed by militarism. The soldier is everything, the artisan nothing, and it is becoming all the time more difficult to assemble a corps of work people for carrying on any kind of skilled industry there.

One remark of Mr. Bayles is especially worthy of note. He says: "The average output of work in a German shop, per unit of labor, is probably not more than half of what it is in this country." This, when further qualified by the greater purchasing power of money there, will show that wages are not relatively higher here than in Germany. The fact is there is not much difference in wages anywhere if measured by their product.

Quoting the words of a German manufacturer, Mr. Bayles writes :

"In a word the manufacturing industries of Germany are becoming more and more embarrassed every year by causes tending to divert labor from the mechanical trades. I can get ten educated and capable engineers for every one good mechanic I can hire. Clerks are so abundant that not half of them can find work. Every man is a soldier. If Germany had nothing to fear except from foreign enemies, we need have no cause for anxiety ; but we are growing poorer every year, and every year finds us less able to market our manufactures in competition with those of other countries."

An article on the copper regions of Michigan, by description and plates, gives a good idea of the celebrated Calumet and Hecla mines, also of the towns of Hancock, Houghton and Calumet, which from appearances have not much increased in twenty years past. The Calumet and Hecla mines have paid thirty nine millons of dollars in dividends.

The following extract will give some idea of these mines :

"The lode is from 8 to 30 feet in width, averaging about 12 feet. There are 2,400 cubic fathoms of copper-bearing rock to the acre. The yield of copper is 1,300 pounds to the cubic fathom. There are 1,300 acres of unexploited mineral land. Reader, figure out its resources. There are 18 shafts on the property. The greatest depth reached is the fortieth level, or 3,850 feet on the incline, or about 2,350 feet vertically. As the ore is mined, its hanging walls are supported by stulls, or heavy pieces of timber. These, in places, are as thick as trees in a dense forest. For twenty-five years these timbers have been put in place until there is now sufficent lumber underground to build a town of the dimensions of the mine. Conceive a city nearly three miles long, half a mile wide, with 18 avenues, and from 20 to 30 cross streets, located on a hillside that pitches at an angle of 38 degrees, and you have a very fair idea of just what the Calumet and Hecla mine would be if its timber were framed into houses."

The deepest workings are stated to be 3,400 feet, which if not a mistake, will be a matter of astonishment to most people. The hoisting works are enormous. Ten tons at a time are raised 2,000 feet per minute, or at a rate of 23 miles an hour. One steam engine is of 4,300 horse power, and weighs 350 tons.

Stone.

SEPTEMBER 1892.

This fine magazine comes to hand with its usual store of useful matter pertaining to the building and decorative arts, interspersed with essays of popular interest, but its principal feature, and this among many commendable, is in the section called editorial comment, in which is found a review of the social and economic circumstance, of our day that, in point of intellectual acumen, stands out in wonderful contrast with most that appear at this day.

We would like to transcribe the whole to these pages, but space limits us to the concluding part as follows :

"It is well, however, not to be mistaken in the meaning of this labor movement, in its evolution it develops illegal and injurious phases, for it extends beyond them and includes all productive interests. Capital is striving for precisely the same condition, in much the same way, but not yet with the same success, from its greater lack of internal discipline. The impelling condition is competition, carried to the extreme by the tremendous over development of productive energy due to rapid multiplication of machinery, until market value has ceased to bear any relation to cost. The conditions of human civilized existence have a limit before which the old maxims of political economists must fall. It is clear that society must soon reach some solution of values in their relation to the cost of production, that, in turn, rests upon the necessities of living, that have no elastic conditions, and leave no alternative. Failing to solve this, society will crumble from the dry rot of anarchy. The instinct that inspired the millers of New York City to recently pool their issues, and that has been productive of numberless trusts and syndicates of capitalized industries, is the same instinct that inspires workingmen and artisans to combine in unions to set a price on their labor without regard to the ability of an employer to hire a cheaper man if he could find one. The instinct is right, both in the case of capital and labor, although in both cases it has been extra legal, and sometimes illegal. Efforts to put down the exercise of this instinct are doomed to certain failure, whether undertaken by all the forces of law or government. The Roman Empire broke itself to pieces in trying to subvert a condition of life that natural events had made essential to the European mind. The complete absorption of the elements of life and livelihood by the monkeries and nunneries of the Reformation era could not prevent its utter overthrow, even when supported by the united armies of the vast empire of Charles V. Neither could Europe prevent the overthrow of medievalism by unity for the destruction of the principles of the French Revolution that Napolean successfully carried through Europe, nor could our own Southern States, although in possession of the arteries of government, prevail against the public sentiment that decreed the downfall of slavery, even although some echoes of it are heard in the Tennessee prison competition, and in the bravoism of Pinkertonism."

The Muscular Amalgamator.

BY C. A. STETEFELDT, E. M.

This is an unpublished pamphlet, printed by the author as a lecture "not delivered" at the California University.

The lecture, compendious in bulk, is far reaching in promises and conclusions, a dissertation on "things in general," and in its serious aspect, if it have one, a reflex of the opinions of a skilled man, trained in the best schools of Europe, brought in contact with expedients and processes of our mountain mining regions — a mixture of the advanced and the ridiculous.

The "Muscular Amalgamator" is thus described:

"He is generally of large frame, and wields the sledge hammer with more skill than the pen. If the biographer inquires into the history of his youth, and his former occupation, he finds both shrouded in obscurity. My own investigations have occasionally brought to light that he started in life as a blacksmith or carpenter, or that he had been shoveling coal in an assay office. His moral conduct is somewhat biased for the reverse of truth. Not that I want to accuse him of wilful lying — oh no! — he only has got so much in the habit of bragging about his remarkable performances that he has finally become convinced of the truth of his own mis-statements.

As a manager of men he has excellent qualities; he can knock a fellow down and swear at him like a sea-captain. Socially he is intimate with Tom, Dick and Harry, and the millionaires Brown, O'Flaherty, and Shultze have the most exalted opinion of his skill and ability. Although he has great contempt for science, and for "scientific cusses," as he calls us, he can make good use of scientific nomenclature. He talks freely of highly metalliferous limestones and of phrenological periods. Tellurides, selenides, bromides and iodides are to him of every-day occurrence.

Of course, he is a fine assayer, and composes his own fluxes, which resemble the prescriptions of physicians centuries ago. He is remarkably fond of being his own assayer, because the statistics of the mill are then much more satisfactory to his company. He is never troubled about reclamations on bullion, and the bankers are eager to buy all bars bearing his stamp. In amalgamation the most curious processes are used: nitric, hydrochloric, sulphuric, phosphoric, acedic and pyrogallic acids are mixed in the pan with soda, potash, lime, salammoniac, nitre, gum catechu, and sagebrush tea. Potassium cyanide is a gift of the gods, and is always kept exposed to the air so that it will gain in strength."

The pamphlet is not published for sale, but copies may be had from the author, at 40 California Street, in this City.

An Introduction to Geodetic Surveying.

BY PROFESSOR MANSFIELD MERRIAM.

This treatise published by John Wiley & Sons, of New York, and sold here by Messrs. Osborn & Alexander, in this City, is one that will form a valuable addition to the libraries of civil engineers and topographers, and is one that aside from its technical and principal part, contains a good deal of value to the general reader interested in scientific subjects.

The terms geodesy and geodetic, come from the generic one "geoid," a name applied to the earth's figure as distinguished from other standard geometrical forms, such as ovaloid, elipsoid and sphereoid, none of which apply strictly to the earth's figure, which is *sui generis*, of special design.

In surveying, the processes and quantities are based on a plane, and accurate enough to define boundaries and courses over limited areas, but for long lines or large areas, such as are dealt with in triangulation, it is impossible to proceed except by geodesy, or taking into account the curvature of the surface of the earth, hence we have the name "geodetic" applied to the work done by the Coast Survey, which would be nearly useless or impossible if conducted on the principle of common land surveying.

Geodesy is therefore in a sense a separate science, and in another sense an essential element in surveys of all kinds, if absolute accuracy is to be attained. In the article by Engineer Kerr, of the U. S. Geological Survey, on the triangulations to ascertain the height of Mount St. Elias, can be seen an example where the geoid figure of the earth would be an element of importance, and without which determinations would be vague even if complete triangulation was otherwise possible.

The most remarkable, and at the same time commendable, feature of the work is the absence of pedantry, such as the subject invites. As before remarked, even the unskilled reader can find in the book a great deal of useful and interesting information. This characteristic is no doubt due to the fact of the author being an instructor in civil engineering, professor in the Lehigh University of Pennsylvania.

The third section on the "Field Work of Triangulation," will be found the most valuable part to professional people, but in the first of the divisions occurs historical matter that will be astonishing to the secular reader. Eratosthenes, 230 years B. C. had discerned the principles upon which could be computed the size of the earth, Aristotle and others having a century before determined its spherical form. "Then for a thousand years," says the author, "Europe was sunk in intellectual darkness — the dark ages, the period of faith when reason was blotted out, except a mere spark preserved in Arabia." The present work brings to mind the altered circumstances under which we now live.

Testing Water Wheels and Machinery.

BY JAMES EMERSON.

On looking into this singular book, we were at once reminded of the sailor who requested from his captain the loan of a book to read in the forecastle, and being told to help himself, took the largest, which proved to be a dictionary. Jack soon returned the book, because, he said, "the subject changed so often his mates could not keep up with it." The book cannot as a whole be crowded within the titular scope of "Teufelsdröckh's Profession of the Science of Things in General (gameinlichwissenschaft). Hydraulics, religion, law, ethics and wire tables come in alternate chapters or sections. The pentateuch, penstocks and turbines; total depravity, horse-power and hierarchy, are joined together if not blended.

Our review of the book must be postponed for some time pending some experiments. A convivial engineering friend we tried it on, soon laid the book down, felt his pulse, went to the mirror and looked at his own face with interest, went out with a sigh and has not been seen since.

The hydraulic portion, or the main portion, contains much of interest and use, among other things, scraps of history in the art that will be new to most readers. An article on screw propellers on page 379, had better be expunged from the fifth edition, this is the fourth. The idea of revolving a screw propeller without progression through the water to determine its force must be a joke.

The author has had much practical experience in testing water wheels and the measurement of power; also has been too close an observer of human nature to have much faith in anything not amenable to a brake test.

Brown & Sharpe Manufacturing Co.

This Company send their annual catalogue, it may be called, containing a list and description of their multifarious products with a number of additions. The works are so well known in this country, or indeed everywhere, that it is scarcely necessary to comment on their unique character.

Nowhere else in the world is there a great mechanical works, either of the same kind or devoted to the same kind of product. How it has ever been evolved into an organized manufacture is not imaginable. Except the Wilcox & Gibbs sewing machines, which the Brown & Sharpe Co. have always made by contract, nearly all that is produced is special and peculiar, tending, in nearly all cases, to an exactness that others seek to avoid. It has been our fortune to have seen, at intervals, the evolution of this strange business, and to know personally Mr. Brown, who was an ingenious watch and clockmaker, that soon branched out of the routine of his business to make watchman's clocks, counting, and other intricate mechanism.

In 1865 the works had grown to furnish work for more than 100 men. The quarters then occupied were cramped, and the ceilings so low that one could reach them. In one case 35 men were crowded into a room of not more than 300 square feet. Now it requires more than 150,000 square feet of floor to accommodate the business, and the "appointments," as they may be called, are the finest perhaps in the world.

The catalogue and price lists are issued in a pocket to 3 to 5 inches, and form an invaluable reference on an engineer's or manufacturer's desk.

"INDUSTRY."

JOHN RICHARDS, Editor.

ISSUED MONTHLY BY THE

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Comments.

The Federal and State elections last month indicate that the people of the country are finding out the injurious effect of changing prices "by law." Such changes are death to industry and commerce, and work great wrong by permitting speculation, and introducing the commercial and personal idea into legislation. The last National administration was characterized by the selection and appointment of a large number of unfit and incapable men to office. What the incoming one will do remains to be seen. Our system of government is one adapted to an honest and virtuous people, and to no other. There is no permanent bar to those personal schemers, and measures that would not be tolerated under a more centralized system. The Nation is becoming unwieldy with a population of sixty millions, and unless capable and impartial methods are adopted in future, there is probability that a conflict of interest will lead to some radical changes.

The smashing of two passenger trains between Edinburgh and London, and at Liverpool, last month, on lines operated strictly on the block and signal system, is evidence that, no matter how carefully and completely precautions are taken, the risks rest on human intelligence and human action. In one case a signalman, exhausted from loss of sleep at home, missed his "points," and a passenger and freight train were "telescoped," as it is called, an operation that is much more destructive there than here, because of the methods of constructing passenger carriages without longitudinal through sills, and other features giving safety in such cases. Ten persons were killed and twenty were wounded, which means in England the absorption of a year's earnings for compensation.

Mr. Andrew Carnegie, the much vaunted protector of American industries, has purchased a good many of his machine tools abroad, evidently because he could save something. His last purchase is a large planing and slotting machine made for him in Leeds, England, and for anything we can detect, in a recently published drawing of the machine, having no other than the most simple elements of machine-tool practice, has not even modern belt-shifting and reversing gearing for the platen movement, and slot levers for the vertical or shaping movement. The feed motion is operated by tappets on the table, a method no tool maker in this country has employed for twenty years past. The table is driven by two screws receiving their thrust, so far as can be seen, on bare collars, and which, by known rules of construction, can never work in unison with rigid connections of nuts and so on, and only when independently driven. We are pretty well acquainted with English machine-tool practice, and concede its merits, except in planing machines, for these it is as bad as can be.

The present depression in the ship-building industry on the Clyde is indicated by the fact that out of 148 building berths only 49 were occupied in October of this year. This means a great deal in respect to the carrying trade, or rather the increase of the carrying trade, because at least one half of this large capacity has been employed on new or added shipping, and not to maintenance, including in that term new ships to replace old ones. No one who reflects on the matter, and considers the circumstances that have called out so vast a capacity for ship building as now exists in England, will doubt that this capacity has gone beyond the normal demands of commerce. The transition from sail to steam for example, which has been going on for twenty years past, was not an addition to the required amount of shipping, but rather the reverse, because the steamers making more rapid journeys require less aggregate tonnage than the sailing vessels. These vast yards on the Clyde, Tyne, Thames and elsewhere, are overgrown.

It looks as if the President and his advisers have been wholly outwitted by the Canadians in the matter of canal tolls, and very much as though the Welland Canal discriminations had a particular object, namely : to provoke retaliation, fire public opinion and thus secure money to construct the St. Mary, and other canals forming a ship way from the Gulf of St. Lawrence to Lake Superior. Whether this was the original scheme or not, it has so turned out, and we will soon be in the position of paying toll to Canadian canals, or permitting their vessels to do a great share of the carrying from the Lakes to Europe and elsewhere Retaliation is a silly, undignified policy, a childish kind of game. There is no compensation either way, and both sides lose. We have heard too much of it for some time past, at least too much for a country like this, able to exact and concede all honest demands without "retaliation."

The cunning methods by which laws can be rendered nugatory is the business of lawyers, who look on public measures as they do on a suit at law having "two sides," in one of which they are retained. The Interstate Commerce Act is an example. People often wonder why there are no convictions and penalties for its violation, but if they will look a little deeper into the matter they will find that such penalties are void because of their severity, which was, no doubt, arranged with that view. The *Railway Review*, in commenting on this matter, says that in one case of a Western railway, if the prescribed penalties had been inflicted, the defendant would have had millions of dollars to pay in fines, and been sent to prison for 400 years. The minimum penalty for violating the law is a fine of $5,000, and imprisonment for one year. Legislation of this kind is supposed to be among the most carefully considered, and if so, what is to be thought of the capacity of Congressmen?

In 1889 there was produced in this country 3,151,412 tons of Bessemer pig iron, which required the importation of about 1,000,000 tons of ore, low in phosphorous, to be mixed with the American ores. Cuban ores are almost free from phosphorous. The Hon. Abraham Hewit, of the Trenton Iron Company, says "Every ton of foreign ore that comes here makes a market for two tons of native ore that otherwise could not be worked, and does not reduce the price of our ores, because they are already sold at one half the price of the foreign ores delivered here." The importation of Bessemer ores should be encouraged in every way possible instead of being taxed, not only because of its being essential in producing Bessemer pig iron, but also because it makes inward freight for vessels that carry American grain out of the Eastern ports, and lowers freight charges accordingly.

We have received from the Commissioners of Patents, Ottawa, Canada, a copy of the new law relating to patents in the Dominion, and, as a matter of interest to our readers, will explain that the term has been extended to eighteen years, and models can be dispensed with in most cases. The Exchequer Court is given jurisdiction in patent cases, over all questions involving validity. The period for importation of new inventions remains as before, for one year, with the privilege of extension for another year by petition. Manufacture must be commenced and continued within two years from the date of a patent. The term is divided into three periods of six years each with fees in the same proportion, and the privilege of extension as under the old law. The section relating to models is equivalent to reducing the fees or expenses of a Canadian patent one half, because models of mechanical inventions usually cost as much as the fees, sometimes a good deal more.

One of our newspapers announces that, as a "decree of fashion,' one must commence a letter on the fourth page. Omitting the decree part, one may ask where else a letter should be commenced? It is reserved for San Francisco printers to put the head of a letter on the first page. We once asked a prominent firm here to instruct us how to press copy a letter commenced on the first page, and they are at the problem yet, perhaps, but leaving the question of copying out, where is one to write next, after the first page is full? Turn over, and write on the opposite page, leaving one blank, and the other filled on two sides? It is a matter of common sense to begin letters on the fourth page, and it is the custom, as the editor of a newspaper certainly ought to know.

We have been watching for the announcement of a steamer, on paper, to excel the *Gigantic*. now being constructed at Belfast. It has come from a "well-informed source," says the *Engineer*, London, and is to be about a quarter of a mile long, and journey between the two continents in 36 hours, 13 minutes and 3 seconds. Of all kinds of fools the marine one is pre-eminent, because he speculates in what he never understands. All these wonderful steamers that have been built in the air have originated with people who had no knowledge of the matter, and for resources draw upon an elastic imagination. It is childish, and injures our reputation and interests in various ways, and the wonderful steamer crank should be suppressed. He does not stop at size, but every little while discovers that marine architecture is all wrong, and a totally new "type" is required — invariably to be constructed with some other person's money.

In another place in this issue we comment on the decadence of economic knowledge when we compare the speakers and writers of this day with those of one hundred years ago. In proof of this may be cited a statement made by a prominent statesman, the governor of a state, in a recent meeting in Brooklyn, New York. He said "England has paid us 230 millions in gold to settle a balance of trade in our favor, and we have got the money now." The audience, perhaps, and the speaker also, no doubt, thought we had somehow got this money out of the British as a speculation, and without an equivalent, whereas they, perhaps, made more money than we did in the transaction. It is the old mercantile theory again, of money balances, put to rest by all sensible people a century ago, and certainly no one in this country in the days of Hamilton, Jefferson, Clay, Calhoun, or Webster would have stood up in Brooklyn and uttered such a sophistry.

From newspaper accounts, relating to the report of the Bureau of Ordinance, not yet to hand, it seems that the scheme of inclined turret faces for certain American war vessels has been abandoned. The effect of even slight vertical inclination in the faces has a result in resisting shot, far beyond what is supposed, or, if not that, in reducing the required thickness and weight of the turrets. Both of these qualities are against the interests of the contractors who are to make the plates, the reduction in weight reduces the amount, and the inclined faces add a great deal to the cost of manufacture. One authority claims the change from the original plans was made to favor the contractors. The difference is such that a contract for plates fitted for inclined faces should never be converted into one for vertical faces, and *vice versa*. The difference in the cost of shaping the plates in the two cases is not less than a third, and the original contract, whatever it is, should be adhered to, or a new one made.

Local Notes.

Mr. L. Heyneman, C. E., in charge of work for the new site of the Fulton Iron Works at Harbor View, informs us that the works are progressing rapidly and favorably. About 300 piles are now driven on the water front, and a good many of the concrete foundations for the foundry and other departments are in. The grounds, consisting of eighteen acres, are at the ends of Baker, Broderick and Devisadero Streets, and are protected on the west, both from wind and the swell; the latter by a double tier of piling to which a revet face of rubble work will be added soon. A large wharf is now being constructed, and unless the weather hinders, the works will soon come in view from the Bay and Marin Shore. The water frontage is 1,000 feet long, and the situation is very satisfactory to Messrs. Hinckley, Spiers & Hayes, who have been fortunate in associating with them in this new enterprise, not cnly investments, but at the same time, experience and skill.

Those curious in such matters can now see the engines of the battle ship *Oregon*, erected at the Union Iron Works, and at the same time as good work of the kind as is done anywhere in the world. They can also see some new machine tools going into place, of greater capacity than exist in any other works in this country, also what is quite exceptional at this time, a works full of business. We have, at intervals, ever since the Union Iron Works were built, been over the plant and have never before seen the same amount of work on the floors. It is, of course, mainly Government contract work, but there is a large share of the miscellaneous kind, local for the Coast, and abroad. The marine dock is busy with double lifts, as a rule, and the time will come, no doubt, when pontoons will be required for shallow vessels, if the dock sinks low enough for that method, which, if we remember, was a part of the original plan.

As our manufactures here become organized and permanent there is more reason for, and value in, trade marks. These are a phase of old, settled manufactures, rather than new ones, but it must be remembered that new manufactures grow old in time, and a trade mark, like some other things, becomes more valuable by age. We do not mean adventitious catch words and grotesque symbols, but typical and relevant names applied to a business or class of machines, such as "*Hydro-Steam*" applied to elevators, which is a good illustration of what is meant. This system is novel, as it has been invented here, and the trade name is one of value, which the owners have so found, and have recently had it registered as a trade mark. The fees are but a trifle, and the privileges last for sixty years by renewal.

Mr. Otto von Geldern, C. E., of this City, is still engaged in procuring and compiling data for the U. S. Engineer Corps in respect to some of the navigable creeks and rivers entering into the bay, and methods of their improvement. It is fortunate that the Government is moving in this matter during the administration of Col. Geo. H. Mendell. At his possible retirement from official life, within a few years, there should be, in the archives of his office, full data respecting the work that has engaged so long a period in his official career, and on which must be based the policy and appropriations for public works of the kind in California.

There is reported the organization of an electric power and light company to transmit current from the Folsom Hydraulic Works to Sacramento, with a capital of one and a half millions of dollars. The distance of transmission is about twenty miles, and the scheme seems a sound one in every way, except that it would be much better for the City of Sacramento to erect and control the whole thing. The people there seem to have more success than is common in managing municipal property, and have already quite a plant for supplying both light and power. The principal problem in the case, we think, will be the lack of water in the American River in summer. The storage capacity, above the dam, is sufficient to make the whole supply available, but it is not much in late summer months, fortunately at that season the power required for lighting is at its minimum.

San Francisco has a claim for modesty in respect to various works carried out here in a quiet manner, that would call for much more noise and ink in other places. The gas company, for example, have erected, on the north side of the City, a gas tank of unusual dimensions that very few people have heard of. It is to hold 2,000,000 cubic feet, is 168 feet in diameter, and the total height 145 feet. The excavations are 37 feet deep. The floor coating is 24 inches thick, of stone and concrete. The walls are 8 feet thick. The iron work was done by the Union Iron Works, and the material furnished here, mainly by the Pacific Rolling Mills Co. The cost of the whole is about a quarter of a million of dollars. This is, except some gas holders at New York and one in Chicago, the largest in this country, and goes to show the fact that electric lighting does not interfere greatly with the consumption of gas.

Messrs. W. T. Garratt & Co. have submitted plans and estimates for a new water works at the City of Modesto, which have been accepted, and in preparing to vote for the required funds to construct the works the City Council elicited some information of interest. It appears that in the majority of towns in California the consumption of water is a little less than 100 gallons a day for each inhabitant. In the Eastern States it is about 75 gallons per head. At Santa Ana, Cal., they have a pumping water works where the cost of pumping is two cents for one thousand gallons, which is perhaps as high as in any other case where good machinery is employed. At Modesto the present cost of pumping and maintenance is about 9 cents per thousand gallons, which certainly admits of sixty per cent reduction. The Stanislaus River is within a few hundred yards, and the elevation required not more than ninety feet. In this, as most other cases, however, the actual cost of water is not the only problem. Safety from fire, enhanced value of property, and the accretion of business which a good water supply invites is the main part of all. Messrs. W. T. Garratt & Co's plans include a high-pressure fire service with storing plant and distributing apparatus complete.

INDUSTRIAL NOTES.

The steam jacket problem that has during a dozen years past called out volumes of discussion, and whole books of formula, with more experiment, perhaps, than any other problem that has ever appeared in steam engineering, should now settle down to the conclusions of the committee of the Institution of Mechanical Engineers, London, who have recently presented a report on this subject. The committee consisted of some of the most eminent engineers in that body, and includes a large number of experiments under all kinds of conditions. The first report of this committee was presented in 1889, and the present one is no doubt to be final. It is difficult, in so much of it as has reached here at this time, to sum up the conclusions that may be drawn from the report, but it will no doubt be available for our next issue. The main part will be the discussion, in which general inferences will appear.

The great engines and pumps employed in pumping out Haarlem Lake, in Holland, are to be removed and replaced by centrifugal pumps, now being made in England. The old pumps were of the bucket type, set in a circle around a great steam cylinder, and operated by levers. The centrifugal pumps are to be of enormous size; the suction pipes 4 feet 10 inches diameter, capable of raising about 100,000 gallons a minute. This shows the progress of centrifugal pumping at this day. The old pumps, in so far as economy of power, could not well be excelled, but the nature of the plant made it expensive to maintain, and it lacked capacity, or had to operate a much longer time for a given duty, than the new one will.

The Mineralized Rubber Co., of New York, proposes grooved bands and grooved pulleys, so as to cause adherance and prevent slipping. It is curious that so much effort and expense should be expended on this matter of slipping belts. The whole thing is a mistake, because belts do not slip as much as they should, when we consider their strength and nature. That is, they do not slip when doing their normal work and when wide enough, but only when over-taxed and the slipping becomes a natural and necessary indication of improper use. In this country we have a tolerably rational use of belts, but in England one is compelled to the view that a leather belt and a pitch chain are regarded much in the same way, and both of them as substitutes for tooth gearing.

The launching of the *Campania*, new Cunard steamer, in October, was a difficult undertaking. The Clyde, at the Fairfield Works, is barely 900 feet wide in the direction of the diagonal launching ways, and as the ship was 600 feet long there was only 300 feet in which to stop the 9000 tons of weight. This was accomplished by means of drag weights attached to the ship by numerous chains of varying length, so that one after another came taut, offering a gradual resistance. The anchoring device was eight heaps of chain on the ground that had to be dragged, a curious expedient, but one not without reason when we come to think of it. The resistance to the ship is somewhat indefinite in quantity, but absolute in nature, removed from all adjustment or judgment of attendants, and all chances of mistake or failure are eliminated. This expedient is no doubt an old one in launching when there is not room, but certainly there has never been a case before when a ship was launched into a canal the width of which was about one half the ship's length.

The chief inspector of the Royal Navy in Great Britain, has in a recent article on the subject, indicated what may be called the survival of forced draught in marine boilers, and places the best pressure at only a half inch of water, or in other words, what may be called natural draught. In a war vessel, forced draught is not so much a method of combustion as an addition to boiler capacity, or a saving of room and weight for boilers; but as Mr. Benbow intimates, the game is not worth the candle, and the chances are that we will gravitate back to the rational mean between high air pressure and no pressure. The effect of high temperature in the furnaces is the principal impediment to forced combustion, but there is also the question whether in all practice, land and marine, there is not more economy and safety in slower combustion.

When Mr. George W. Dickie, of the Union Iron Works, lectured last summer, at the Academy of Science, on the subject of "Freight Steamers for Ocean Service," his estimate for fuel consumption was disputed as being too low, but was afterwards very fully maintained by statistics showing the amount burned by White Star freight steamers, running between New York and Liverpool. Now even this performance has fallen behind. The steamer *Heighington*, with 6,100 tons displacement, has recently run from Liverpool to Madras, India, 7,512 knots, or 8,639 miles in 830 hours, or about nine knots an hour, consuming for propulsion 13.75 tons of coal a day, or 475 tons for the voyage. This the *Steamship* says is at the rate of half an ounce of coal to each ton of dead weight carried one mile, or 32 tons carried one mile with one pound of coal, or one ton of freight carried 32 miles with a pound of coal. This seems marvelous. The above named coal consumption was for power alone, other uses consumed about half a ton a day. Mr. Dickie can amend his tables now.

There has recently been made, on the Great Eastern Railway, in England, a test of locomotive performance, the most careful and thorough to this time, conducted or observed by Mr. Bryan Donkin and Professor A. B. W. Kennedy. The tests were made with the locomotive stationary, driving a portion of the works at Stratford, and then on two runs of 95 miles, hauling a train of about 300 tons. The observations extended even to the temperature of the gases of combustion at various points, and to their analysis. It is difficult to see how all the various data could be observed and recorded, especially on the running tests. The consumption of coal was 2.85 pounds per hour per horse power and 19.75 pounds per mile run. The evaporation was a little more than 10 pounds of water, being 10.10, 10.34 and 10.16 pounds for the three experiments, and computed as equal to more than 12 pounds, from and at 212 degrees, the temperature of the feed water being from 50 to 56 degrees. The tables given in No. 1,399. *Engineering*, London, will be a matter of interest to locomotive engineers in this country.

In some recent experiments where an iron planing machine was driven by an electric motor, it was found that eight horse power was consumed, and that at the end of the stroke double this amount of power was required to reverse the machine without checking the motor. This shows a waste of one half the power that must be provided and consumed, mainly in dragging a massive table, and the work to be planed, backward and forward, while the cutting tools remain stationary. Eight horse power applied at the rate of 20 feet per minute, a maximum cutting speed in planing heavy work, equals a strain of 16,500 pounds, of which perhaps not one fourth is applied to the work, or utilized. There is perhaps no process where more power is wasted than in planing, and needlessly so, because it is both cheaper and better to move the tools and let the work be fixed. It requires half the room, less than one half the power, and at the same time secures truer work. No platen or carriage planing machine remains true for any length of time, unless "wedged up for wear.

Mr. Albert D. Pentz, who is a good judge of the matter, says American files are below comparison with the Swiss and some other foreign files, which is a truth of fifty years' standing, and we fear is likely to remain one unless machine processes can be made to supplant painstaking hand skill ; but there is another phase of the matter. Mr. Pentz says that from some inquiries made, he concludes that in one case at least, the steel used for American files was bought, or could be bought for four cents a pound. This is dishonest and disgraceful. There is no steel fit for common files that can be bought at twice this rate, and none for fine files at three times the rate. This matter of files is one of unhappiness to all who purchase or use them, and places us at a great disadvantage in some kinds of manufactures. If there is no skill or enterprise to produce good files there should be no impediment to buying foreign ones. We hardly think, however, the case is as bad as represented.

Metallic boats are now made in England in two halves, stamped out or pressed into form from soft steel plates, the two halves being riveted together with a stem keel and stern post, all in one piece, between. Considering the complicated forms with which malleable plates are formed, copper for example, there should be no trouble in making the sides of a small boat in the same manner, and it would certainly be better in various respects, than the old method. Ribs would be required, perhaps, in some parts for stiffening purposes.

Prof. C. B. Dudley, chemist to the Pennsylvania Railway Company, has been analyzing some of the alloys sold for machine bearings, and if his renderings are correct, as they no doubt are, there is a good deal of "humbug" in the various compositions. The manufacture of bearing metals, like medical treatment and watch repairing, is done on good faith. The pretended secrets of the business are sophistry, and the best way to secure good metal is to procure it from some one who will honestly use the proper elements in mixing. In Professor Dudley's analysis the element of tin appears in most of the reputable mixtures, and in some of them not at all, as in "magnolia metal," where the analysis is: "lead 85.55, antimony by difference 16.45 with traces of iron, copper, zinc and possibly bismuth." American anti-friction metal: lead, 78.44; antimony, 19.60; tin, 0.98; iron, 0.65. The better class of metals have a base of copper and tin from 2 to 10 per cent. The analysis of metals is a regular department of the Pennsylvania Railway's laboratory, and has been conducted for a dozen years past.

MISCELLANEOUS.

The Dutch have assumed a herculean task in pumping out the Zuyder Zee (Cider Sea) but that makes no difference, the work will go on to completion. Nothing is ever commenced and abandoned in that country. The cost of the undertaking is estimated at seventy-six million dollars, but the reclaimed land will far more than return this investment. The main dyke will be 26 feet high and 20 miles long. We gave some time ago an account of pumping out Haarlem Lake, a similar but less expensive undertaking. The reclamation of sea-covered lands in Holland is a wonderful feat in modern engineering, or within two hundred years past, because it is an old art there.

The Victorian Government, in its fatherly way, pays a bonus to those who will plant orchards in the irrigated lands along the Murray River. For ten acres in raisins, grapes or currants, $100 an acre, and $25 a ton on all the fruit produced. For figs and prunes, apples, almonds, lemons, olives, peaches, and so on, the bonus is $15 per acre, and a further bonus for each box of fruit exported. We are not able to conjecture conditions, other than economical stupidity, that will permit a tax to be collected from one industry and paid over to another one, but will venture the opinion that this government meddling with private business will do no good in the end.

There is produced in this country about 7,000,000 barrels of salt of 280 pounds each, worth at the works $5,000,000. Nearly one half of this is produced in the State of Michigan from immense beds of rock salt lying under Lake Huron, extending all the way across into Canada. The price is generally assumed at $1.00 per barrel, or $8.00 per ton of 2,240 pounds. This is about four times the price in Europe, where it costs about $2.00 per ton. One works in Michigan produces 2,000 barrels a day. A gentleman, who recently visited the works, and secured particulars respecting the investment in plant maintenance, wages, and other outlay, concludes the cost of manufacture is less than 13 cents a barrel. At Syracuse, N. Y. there are great salt works, the product of which was, in 1888, contracted at $3.15 per ton, or about 45 cents a barrel.

Sweden and Norway were joined under one crown in 1814, their union relating to the sovereign, a military alliance, a joint consular service, and some other matters, but it was no union such as is commonly made in such cases. The King had a veto power, but never dared to exercise it in Norway, where all acts of the "Storthing" or Parliament, receive two years' consideration, and consequently need no interference by an executive officer. The Swedes about ten years ago adopted a system of taxing imports that has not worked very well, or at least Norway, which is the poorer country, one half as large as Sweden, has outstripped her in commerce and otherwise, and now wants a separate consular service, and for other reasons is discontented with the union. Norway ranks high in her merchant marine, standing third among the principal nations, does not squander money on an army and navy, and is one of the best governed countries in Europe.

In the Tipton colliery district in England there was raised last year 27½ times as much water as coal, the whole amount being over 20 millions of tons, the cost of raising the water was less than half a cent a ton. The amount of water raised by pumps in this district, or by the "commissioners pumps," as it is stated, reached sometimes, 11 million gallons a day. This seems like getting coal under difficulties, and goes to show that with present means the deeper coal veins in England cannot be profitably worked.

The four principal collieries in Vancouver, B. C., employ 3,200 people, of which 510 are Asiatic people, Chinese and Japanese. The product is over 1,000,000 tons a year, of which 700 tons a day, or about 25,000 tons a year, goes to the Southern Pacific Company. The Union mines, which produced, in 1891, 114,792 tons, belong in part, or mainly to Stanford, Crocker and Huntington. The product is set down in tons by Consul Meyer at Victoria as follows :

	1888	1889	1890	1891
Nanaimo	258,817	223,870	389,505	527,457
Wellington	198,392	273,383	174,496	345,182
East Wellington	30,092	51,372	44,602	41,666
Union	2,000	31,204	69,537	114,792
Total, Tons	489,301	579,829	678,140	1,029,097

These coal fields, if accounts are true, do not compare with what exist in Washington, and, if so, there should be no want of fuel in San Francisco with these resources.

Locomotive Engineering has published a fine supplement plate showing a train, weighing over two thousand tons, that was recently hauled from Chicago to Philadelphia by the same locomotive, except being assisted on the Alleghany Mountain grades, and in two other grades near the terminal. It required 43 tons of coal to move the train from Pittsburgh to Philadelphia, 354 miles. The locomotive was a consolidation, one with cylinders 20 inches diameter, 24 inches stroke. The furnace, 9 feet by 3 feet 6 inches, indicates the enormous capacity of the engine. There were 40 cars, each loaded with 66,000 pounds of wheat, making up a train 1,602 feet, nearly a third of a mile long. One, in considering this feat, is reminded of the tendency in all kinds of carriage, land and water, to enormous loads. The economic reasons are competition in the case of railways, and speed in the case of steamers, and the mechanical conditions are opposite. Dimensions increase the speed of steamers, but hinder trains.

ELECTRICITY.

THE ELECTRICAL STORAGE PROBLEM.

It may be given to some gifted person with occult powers of penetration to find out from the conflicting statements, opinions and history, what the real status, hope, and promise of the accumulator system is, in electrical economy.

The business relations that storage bears to the generation and sale of electricity one can see in so far as that by storage a considerable saving, and at the same time independence can be gained, neither of which are objects likely to be promoted by the generating companies, on business grounds. There is always a margin of profit in the "unused" amount of current, as in the unused amount of water supplied, and direct connections makes this a profit, but leaving all this out there is the question of fact in the case which is most perplexing of all.

For example, the *Street Railway Journal* of November, says:

"Two railway companies in New York are preparing to test storage battery cars in actual practice. One of these companies is the Second Avenue Railway Company, which will soon have ten cars in operation on the Waddell-Entz system, on Second Avenue between their main depot on Ninety-sixth Street and the Harlem River. The Ninth Avenue Railway Company officials are trying an Acme storage car."

Now why two prominent lines in New York should attempt the accumulator system for street railway service after it has been condemned in general terms by prominent electrical engineers, is hard to understand. The fact is "they do not know," and looking at the mechanical and dynamic phases of the matter, a safe inference is that on fairly level grades, street traffic will in the future be carried on by auto-mobile apparatus, or by cars that carry their own power as steam locomotives do.

Weight, which is commonly urged as an impediment, is an essential element of traction, we cannot have one without the other, and as soon as the load can be made a practical factor in operating, as it must be, that objection will disappear, or rather will be absorbed, so perhaps with other objections, such as the maintenance of plates, we may at any time expect an imperishable kind.

In England the Electrical Storage Company, of London, have begun guaranteeing or maintaining the cells of their batteries, and the result is so much in their favor, that they are now sending out circulars offering to undertake the propulsion on urban railway lines for a percentage of the traffic receipts.

The self contained system, as it is called, in which each car has its own motor and power, permits immediate substitution of storage cars on horse lines, without any change of the permanent way, and we suspect this method of contracting for propelling power is to become a wider system. It is in the line of centralization and for that reason invites capital.

NOTES

There is slow progress made with alternating current motors. It is five years since Nicolas Tesla promised a development in this way and so far as known, neither he nor any other electrician has set up insuperable difficulties as a reason for this slow progress. To those unskilled in the subtleties of electric phenomena, it would seem that any generating agent should be capable of being reversed, or in other words, give out as a motor what it created as a generator, less certain losses as in the case of engines for liquids and gases. The same agencies that raise or compress these will give out again a fair portion of the energy consumed in the first case ; so should an alternating generator, and it will no doubt in the end.

The power that can be brought to bear in resisting a legitimate patent is exemplified in the case of Edison's claim to the filament incandescent lamp, lately confirmed by the U. S. Courts. The coalition, forming the "General Electric Co.," of course disposes, in a great measure, of infringement, but there are other companies, notably the Westinghouse Electric Manufacturing Company, that will have to pay tribute or abandon the Edison filament lamps. The Thomson-Houston Company had previous to and anticipating the decision in Edison's favor, been engaged in producing a new lamp, aided by a Mr. Langham, who proposed to make a lamp without the carbon filament. Whether successful or not no one outside of the company knows, but if so, then the difficulty to other makers will be increased by a second bar. We have a good many times predicted that the final outcome would be an acknowldgmemt of Mr. Edisons claim to his lamp, because in the shades of difference that have been shown the original invention always stood out boldly.

Some one has, thoughtfully, invented the term "electromotive," and thereby earned much commendation. Electric locomotive is too long, and no more relevant — not so much so as "electromotive." "Locomotive" is itself, as a name for a railway engine, a kind of joke, a term that would stand improving in so far as both its euphony and relevancy, but then, that may be the reason it was adopted, because custom nearly always tends to the word least appropriate and, if possible, with a strained meaning.

The De La Vergne Company, of New York, makers of refrigerating machinery, have fitted up a department of their works with electric motors for driving the machine tools separately, depending on the motors for stopping and starting. This is not perhaps the most extensive application of the kind, and is moreover experimental as will be seen from the motors being set on the floor and driving to the usual countershafts overhead. If machine tools are to be driven by electric motors the best plan will be to have the tool makers adapt the driving gearing for that method, and connect the motor as an integral part of the machines. To set the motors around a shop on the floor and connect to overhead gearing is no proper installation for electric transmission, and we doubt its success as a permanent arrangement.

Mr. T. H. Leggett, president and manager of the Standard Consolidated Mines at Bodie, is about to install an electric transmission of considerable importance. The power is generated twelve and a half miles distant and conducted by a bare wire supported on 662 poles set at spaces of 100 feet. The generator is to be of the Westinghouse multipolar alternating type, of 160 horse power, driven by four Pelton water wheels, 21 inches in diameter, on one shaft and connected directly to the armature shaft by a flexible and insulated coupling. The head of water is 350 feet, and the whole generating plant stands on a foundation only 5 × 20 feet. Mr. Leggett has the work all in, except the dynamos, which are behind time, and hopes to be running in a month or two. This scheme for cheaper power will put the mine on a new basis, and will no doubt save in fuel what will be a reasonable profit on the whole investment from this source alone.

MINING.

NOTES.

There is prospect of a smelting plant being erected at Los Angeles, Cal., and promise of its maintenance by the minerals in the mountain range opposite there, especially in Inyo County. The announcement is made with some promise of fulfillment, because that city has been less prolific of what may be called paper industries than most of her northern neighbors. The papers there speak of using Inyo County coal, which we imagine will have to be converted into gas for smelting purposes.

Virginia City methods are peculiar. The net yield of ores is $15.81 per ton, and the expenses of mining, reduction, etc. was $17.87 per ton. At some mines in Montana, which is certainly not a cheap place, the ore yield is estimated at $6.22 per ton, and expenses at $6.98 per ton, or less than one half as much as on the Comstock. The cost of reduction, or milling, at Virginia, is $6.00 to $7.00 a ton, which by all precedents and comparisons seems to be two prices at least. The fact is there is no chance for returns to the shareholders, and the whole property is blotted out, unless there are some more honest methods of dealing with the owners of the mines.

The North American Transportation & Trading Company of Alaska formed this year, and which has even already revolutionized the mining industry in the interior of the country. A steamer was taken up in sections to St. Michaels, on Norton Sound, 80 miles from the mouth of the Yukon, and there put together. She was then loaded with provisions, the framework for a trading post at Upper Ramparts, 2,000 miles from the river mouth, and a complete hydraulic plant. Many of the miners have decided to winter up country this season, and they will now be able to get provisions, etc., and at a reasonable rate. The placer fields on the Upper Yukon are rich, but as flour sold for from $15 to $18 per sack, the miners had to abandon digging that did not pan out $10 per day, for with the short season and these high rates they would have nothing left at the end of the season. Now this is changed.

Flour will be sold for $3 per sack, and everything else in proportion. As soon as navigation opens next year, the company propose sending up the river $150,000 worth of provisions and machinery, when some important results will be obtained.—*Engineering and Mining Journal.*

A correspondent of the *Engineering and Mining Journal*, writing from Australia, says the gold yield in Bendigo, from January to July, six months, was 112,500 ounces, and the dividends declared, $698,500. Assessments were $406,115, leaving clear earnings of $292,385. The yield increased in July, and no doubt since then. The New South Wales and Queensland mining industries are reported as flourishing, and if so, it is about the only interest there that can make such a claim. Australia, especially Victoria, is in a state of business coma, as our merchants doing business there have reason to know. The Australians have set out to introduce some new systems of management, assuming their country was an exception to those laws and methods that the world has found most beneficial elsewhere, and while there is a good deal to commend in what they have done, there is also still more to avoid.

SAN FRANCISCO MANUFACTURES.

Little by little the people of this City are beginning to see why our manufacturing industries do not expand and grow. The least causes are first discussed, and the main one — cost of fuel and material — is left out. It is good philosophy to say that we are not situated to do manufacturing, but it is not good "fact." Switzerland, almost devoid of resources, except power, next to Belgium and England has the most manufactures of any nation in Europe. New England has few natural resources, but is our chief manufacturing district. The Pacific Coast has more resources than either, and a world to the west and south to consume the products.

If prices here were natural, or if our commerce was natural, not only coal, but nearly all the elements of manufacture would be as cheap as in the Eastern States. The nature of our exports is such that freight inward could be reduced to a low rate, and is so now when there is freight at all. Scrap iron, on which our iron-making industry is founded, is as cheap here as anywhere in the United

States. Tin and other alloy metals, should be cheaper than in the East, and fuel should be but little more.

Shipbuilding material, if it could be brought here in vessels coming for wheat and other food products, would be about as cheap as in Pennsylvania, and we would build and repair four ships to one under the present method of taxes, navigation dues, port charges, and the dear system now existing. We would also buy more in Pennsylvania than we do now, and no one would be injured. In respect to skill, division of labor, organized manufacture, cheap production, and so on, these will follow fast enough when they are possible, but not sooner. These are sequences, not causes.

Wages are high, but are on the principle of general dearness, and cannot be maintained here above a normal standard, when travel to this Coast is cheap and easy. A dollar's worth of work must bring a dollar's worth of product, and will, no matter what the circumstances are. The unions are but a reflex and sequence of other combinations such as exist on all sides, and derive their support and tolerance from false ideas of business and general chaos of prices on this Coast.

Next to dear material, fuel, light, water and rents, is dear transportation. Of this we need say nothing. It is a subject worn threadbare, and is second among the generic causes that hinder our manufactures. It does no good to criticise methods, or disparage skill. A building must have a foundation, and no human effort can build up skilled industries in the face of adverse economical conditions, and where there is constant meddling with values, and quarreling with our best customers, as in Chili, Canada, Australia, and Hawaii.

It seems that the blunders in our national policy and mistakes of administration are so arranged as to act directly against the interests of the Pacific Coast.

SMOKE PREVENTION.

We mentioned last month the report of a special committee appointed at St. Louis, Mo., to investigate the subject of smoke prevention, and some of the results or facts arrived at. Since then we have sent for and received, through the Engineers' Society of that city, a copy of this report, and are astonished that it has not occupied a more prominent place in the technical and trade literature of the day, and must conclude that it has proved more profitable to advertise smoke-consuming apparatus than to promulgate information respecting the nature and limitations of that operation.

The report occupies 47 pages, of the size of these, and as before remarked, is no doubt the fullest and most complete consideration of the subject that has been undertaken in this country. It consists: (1) Of a section on the principles and reactions upon which combustion depends; conditions favorable for producing smoke, and those required to prevent it. (2) On various classes of fuel users and the relation to the smoke problem. (3) Conditions under which fuel is burned in St. Louis boiler plants. (4) Requirements necessary for a successful smoke-preventing device. (5) Classification of important types of smoke-preventing devices. (6) Experience in other cities relating to the abatement of smoke. (7) Conclusions and recommendations.

We mention these heads with a view to recommending that our readers interested in the subject will send for a copy of the report, which can be procured from the Commissioner of Public Buildings, in St. Louis.

Our space does not permit quotations from the report copious enough to have value, but there are one or two suggestions that it gives rise to that may be mentioned. The committee sent out, through the City Boiler Inspector, eleven hundred circulars of inquiry to various steam users, requesting a report upon various facts in connection with their plants. To these only seventy-eight answers were received, a matter not to be wondered at when one reads the circular. It was entirely too long; involved too much work to answer, and was of a nature which would lead in most cases to its objects being misconstrued.

Out of seventy-eight who replied to the inquiry, seven only were using smoke-preventing apparatus, and out of these seven but one was satisfied with the result, and he was using a device of his own invention.

The significant part of these seventy-eight reports is found in the remark of the committee that the margin of boiler capacity is such "that 45 out of 100 of the steam plants in St. Louis could make no use of the general run of 'smoke cousumers' without risk of shutting down" because of the slower combustion demanded. The average of fuel burned was 16.1 pounds per hour to each foot of grate surface. The maximum was 31.2 pounds, and minimum 7.5 pounds per foot.

This brings us to the main inference in the present, as well as all other reports and investigations respecting smoke consumption, namely: that it is mainly a problem of fast and slow combustion, or in other words, of ample and deficient boiler capacity. The committee erred, no doubt, in not setting forth this fact more prominently in their report. The secret of smoke-prevention is slow combustion; or to state it in a better way, smoke-prevention is possible only in connection with slow combustion, and when we say possible, that term is to include such methods of firing as can be secured by daily wages. In England, where there is maintained very effectually, ordinances against smoke-making in the large cities, the result has been the development and almost exclusive use of boilers having nearly double the capacity it is common to employ in this country.

Ordinances to prevent smoke-making should limit the amount of coal burned on grates. This would be getting at the root of the subject, and would be an ascertainable fact. All attempts to define in words how much smoke shall or shall not be made, have been failures, and in the nature of things must be. No law that leaves the degree of its infraction a matter of opinion, will be obeyed. The ordinances of Cincinnati provide that the emission of smoke shall be prevented "as far as possible." We imagine that no one has been fined under this rule. Chicago has a much shorter and better ordinance, corresponding, except in verbiage, to the English law, but it has done no good. The fact is, that, in this country at least, any successful law or ordinance for smoke-prevention must deal with ascertainable facts, as well as manifestations left to opinion, and of such facts, the first and most important is the rate at which coal is burned on grates.

The first thing required is boiler space for both water and steam, that will permit slow firing, then smoke consuming will be possible and legislation will apply, but to order the owner of a steam plant to perform an impossibility will never accomplish much, except the waste of money spent in law making and law procedure.

There is now some reaction toward slower combustion and larger boilers. The Edgemoor Iron Company, at Wilmington, Delaware, have been building up slowly, but successfully, a business in making slow combustion boilers, and the boiler makers here are quite ready to fall in with that method.

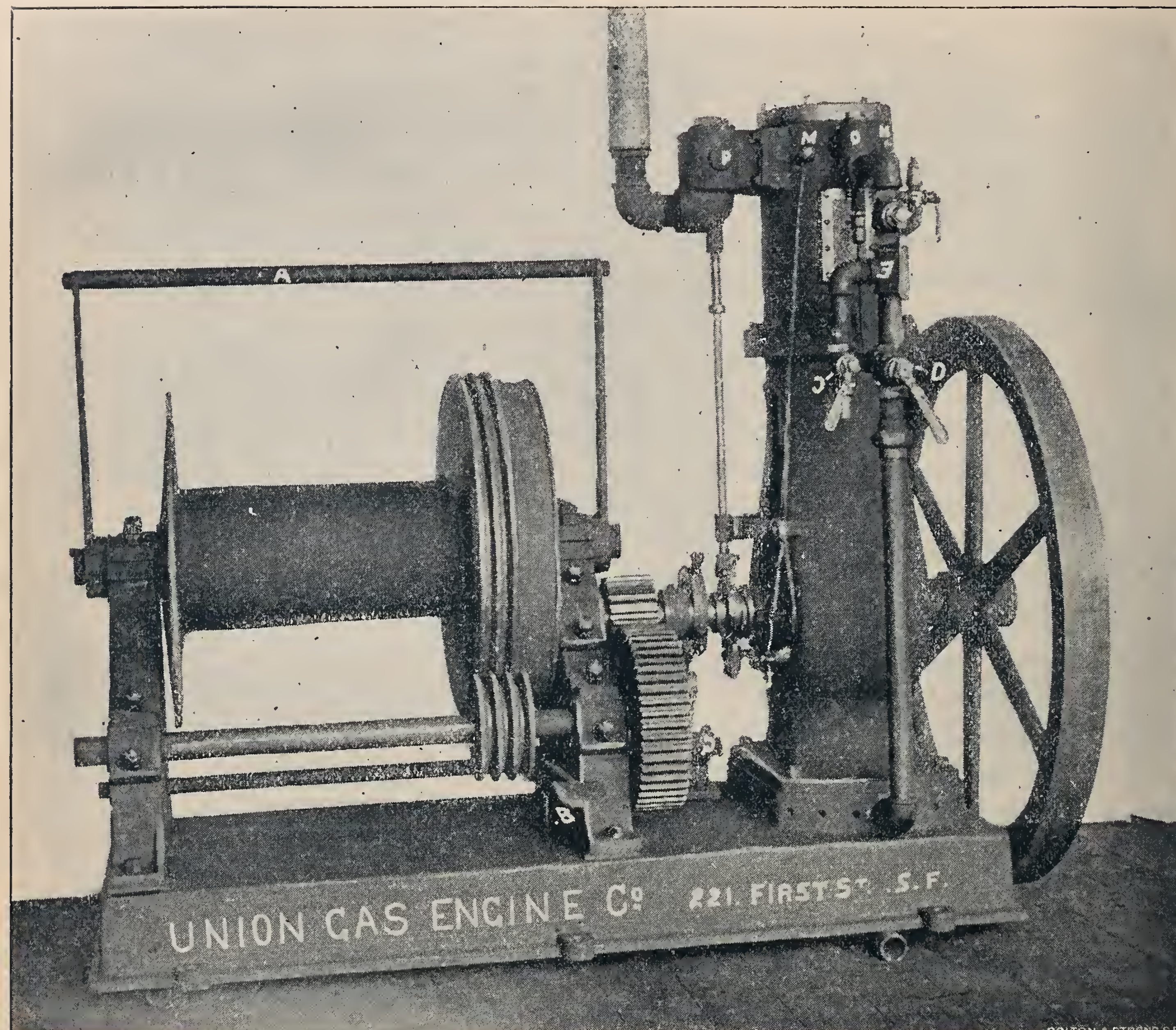
CONTINUOUS RAILS.

Mr. A. J. Moxham, of the Johnson Co. of Johnstown, Pa., makers of railway bars and fittings, read a paper before the American Street Railway Association at Cleveland, Ohio, in October last, describing some careful experiments in continuous rails, that is, rails rigidly fastened with no provision for lineal expansion. The rails used were connected by heavy plates on the sides and nine bolts on each side of the joint, fitted in reamed holes. The rails were of the street railway girder type, 6 inches deep, weighing 78 pounds per yard, and the length experimented with was 1,160 feet. This section under variations of 111 degrees of temperature in the air and careful measurements made throughout a year, from fixed marks, showed that the rails "did not move at all" but were held by their attachments, or as Mr. Moxham says, "by the road bed."

Observations of temperature were also made at depths of 7 and 10 inches in the road bed, showing changes only from 5 to 9 degrees less or more than the atmosphere, and this seems the strangest part of all, is indeed incredible, but accepting all the data, which seems to have been observed with much care, there is no escaping a conclusion that very little is known of the physical changes in permanent way of the kind.

The Johnson Company about a year ago procured a plant for electric welding rails, and there is an approaching conclusion that before long rails will be welded continuously in place, so there will be no joints and consequently a much longer life of the rails attained. The idea is not new, as evidence cited in the *Railway Review*, goes to show that J. R. Brunel, thirty-four years ago laid in England a quarter of a mile (1,320 feet) of solid rail, and that gauges set at the end showed no movement by reason of changes in temperature.

On the other hand there are statements showing a serious disturbance of permanent way by reason of expansion and contraction, so that on the whole the safest way will be to conclude that very little is known of the matter at the present time. One principal factor seems to be omitted in the cases above noted — the expansive force of the rails under changes of temperature, and what kind of a road bed or other restraining means is required to hold rails against such expansive force. This seems to be the main point in the problem, and the indeterminate part.



GAS ENGINE HOISTING MACHINE.

The Union Gas Engine Co., of this City, have been for some time engaged in adapting their engines to hoisting purposes for mines, cargoes, and other purposes, and have succeeded in very satisfactory results. The illustration above shows a four horse power engine, and hoisting gearing, self contained, ready for use.

It is a wonder that this has not sooner been done, because there are certainly a good many reasons in favor of this kind of power for prospecting work, and also for small mines where a limited amount of material is to be raised. The weight of the machinery is much less in proportion to its power than a steam engine, and is easily arranged in sections for packing. The fuel is so concentrated that its transportation is scarcely to be compared to. wood or coal. What can be carried by one "burro" will supply four horse power for a week. Water is another difficulty in the case of steam power. That drawn from a shaft is unsuitable for a steam boiler, and it so happens in arid regions, especially to the South, that water is not attainable in experimental workings. With a gas engine the waste of water is only what may escape at joints in circulating and cooling apparatus, and is, indeed, none at all after a small tank is once filled.

On the whole there is so much in favor of the gas or vapor engines for small hoisting plants, and for inaccessible places, that we may look for a considerable extension of the engine industry in this direction. The Union Gas Engine Company have had such engines at work for some time past, and are now improving them in several respects.

SELF RELIANCE.

There is a great deal of declamation and writing in respect to the employment of foreign engineers and officers on American vessels.

Without in any way criticising the merits of the matter, one feels like inquiring why these particular callings are singled out for special law, and why land engineers, mechanics and professional people should not have the same protection if it is to exist at all. A much more manly and in the end, successful way, would be to make it impossible for foreign people to compete, by excelling them in skill. We do not know any inherent quality in American people that makes them inferior and unable to cope with other nations in steam engineering or navigation, on the contrary believe our people excel in these things. The Government has, since its inception, been conducted on that assumption, and all of our industries and professions have been thrown open to the people of the world, and it seems a little late at this day to plead incapacity. We note in some of oui exchanges, protests against the employment of Professor Biles of Glasgow to assist in designing the new American mail steamers, and cannot see what difference it makes where Professor Biles was born if he has the required skill. Our own experience in this class of vessels is limited, and if it were not, there is no harm in bringing in foreign skill if it can promote the general objects.

All of our works in this country are more or less dependent on the employment of skill acquired elsewhere, and other countries are at the same time benefited by the employment of American skill. How nearly the matter is balanced we do not know, but no doubt with a preponderance in our favor in many cases, and there is a graceful acknowledgment of it in nearly all countries.

It would be a kindness to those who do not consider themselves able to go out in the world and compete, if the government would make some special provision for them on the ground that the "world owes every man a living," which seems a favorite motto with the class of people who clamor for government aid. There are undoubtedly a great many people who have not faith enough in their own powers or those of their country to assume independence and court competition. We are perhaps bound to respect their opinions when honestly entertained, but we need not share their views nor call it patriotic to plead inferiority.

When our foreign shipping was protected out of existence by navigation laws, American officers, masters, and mates, could be found scattered all over the world's marine. They did not seek sumptuary aid, but went out to ply their calling wherever it was wanted. There was suffering to be sure, but as now remembered, no appeals for governmental aid.

The exhibition next year in its nature and spirit is a direct controversion of this spirit of self abnegation. We invite the world to bring here and exhibit its achievements in all kinds of industry and art, evidently in a belief that we can excel or emulate; if not in all, in most branches. It is a spirit of fair play, manly and self reliant.

It is a common thing to blame upon engineers the failure of dams, bridges, or other works of the kind, when, as a matter of fact, the blame lies in other quarters altogether. It is possible, in some cases, but not many, that such failures are due to mistaken estimates and unseen contingencies, but the main cause is the struggle between money and safety. An engineer always prefers a safe course, and never courts danger or failure unless compelled to do so, but the cheapest man usually gets the work to do, and, in the struggle for existence, the solid, safe bidder with his more expensive plans is left out.

A NATIONAL DEPARTMENT OF HIGHWAYS.

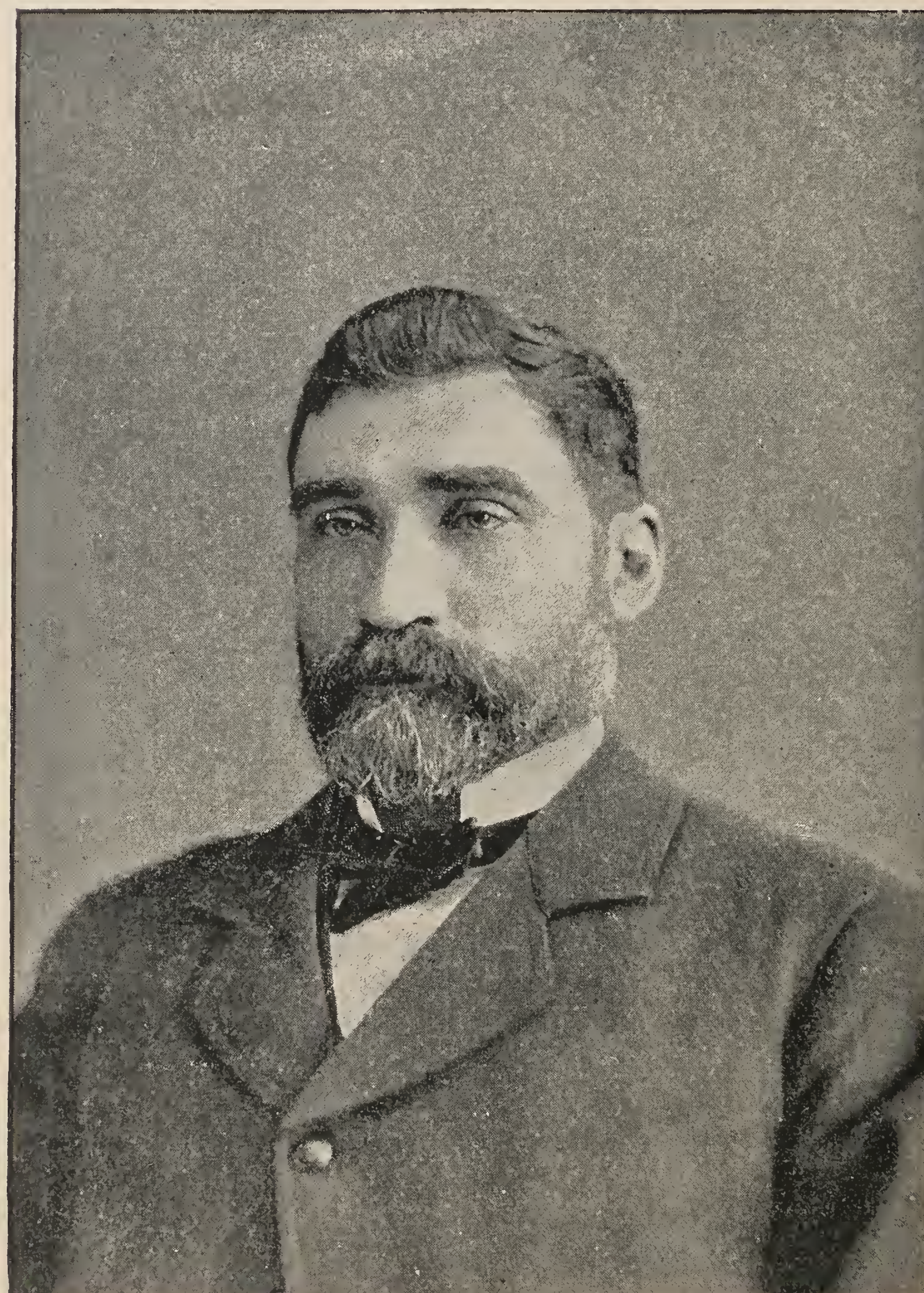
We have received from Mr. Albert A. Pope, C. E., of Boston, Mass., a letter enclosing blank petitions to be signed, praying Congress for the establishment of a National Department of Roads or Highways and the promotion of means to instruct students in the construction of roads.

For comment, the first thought is, why should people be obliged to "petition" for an act of Congress, due alike on grounds of expediency and right? If the people of this country could be made aware of the enormity of our roads, in comparison with most other countries, even poor countries, not making pretense to our natural advancement, they would be astounded at the situation. When we consider the millions of money that road improvement would add to earnings and the farther millions it would add permanently to the value of lands, we may well stop and wonder what cause has retarded this branch of development in the country. Roads are a measure of a people's internal civilization, an exponent of their thrift and patriotism, an index to the public spirit of a country or people as compared to their individual enterprises.

"Person" is the key note of modern affairs. "Public" is nearly eliminated from thought and action. Whatever the public uses, languishes for the want of interest. Our people do not know the deplorable condition of our roads compared with other countries, and their attention has been absorbed in railways. These have been pushed far beyond economical limit in respect to the public good, and are in a sense antagonistic to both roads and waterways. The railways are private property and their construction has been promoted by every act that private interest can invent. Public highways have no such objects, or promotion. They are the outgrowth of concern for the country's good.

It is high time now that some of the attention heretofore bestowed on railways, and the vast grants and concessions given to private, and in most cases ungrateful, companies, should be turned to the improvement of roads.

A Department of Highways and a National College devoted to instruction in this branch of engineering is a modest beginning and might, as before said, well take the form of a demand on the part of the people. Our columns are open to the discussion of this problem in so far as this Coast, and we invite contributions relating thereto.



JOHN RICHARDS, M. E.

PRESIDENT OF THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

The following extracts from an article contributed to *Cassier's Magazine*, by Mr. Otto von Geldern, Secretary of the Technical Society, are, with the plates, reprinted by permission of the Magazine Company :

The Technical Society of the Pacific Coast, the most important organization of the kind on this side of our immense country, is peculiarly situated in its environment, of which we will, in the first place, make some explanation.

In that section of the United States known as the Pacific Coast, twelve hundred miles long, averaging from two to four hundred miles wide, and embracing, in whole or in part, six states and territories, there is in proportion to population a much greater amount of what may be called "technical activity" than in the Eastern States. What this proportion may be we cannot say, because even agriculture, in most of its phases, is of an engineering character, and when allied with irrigation it becomes clearly so.

Not only is the amount of engineering, in the full meaning of its technological sense, more extensive in proportion to population than in the eastern portion of the Republic, but the pursuits are infinitely more diversified. In this respect there is no parallel that can be referred to. The narrow market, or rather its diffused condition, prevents the organization and centralization of industry. There is a cosmopolitan population furnished from all parts of the world — people who have brought with them their skill and acquaintance with the useful arts and professions. The search for a mild climate, and the sanitary conditions that exist on the middle coast, have caused an influx of all classes much faster than assimilation was possible. These people cannot be idle, hence there is scarcely a department of human industry that is not in some way represented among the multifarious pursuits of the Pacific Coast.

Among these industries is mining, devoted to nearly all kinds of minerals, involving numerous reduction processes with the plants for carrying them out, requiring mechanical apparatus the most complicated and extensive that has ever been produced in any country for procuring, raising and conveying minerals and water.

Hydraulic operations have been carried on to an extent and of a character that have made the Pacific Coast a center of research ; this field has produced many marked advances in the conservation, con-

LUTHER WAGONER, C. E., E. M.

VICE-PRESIDENT OF THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

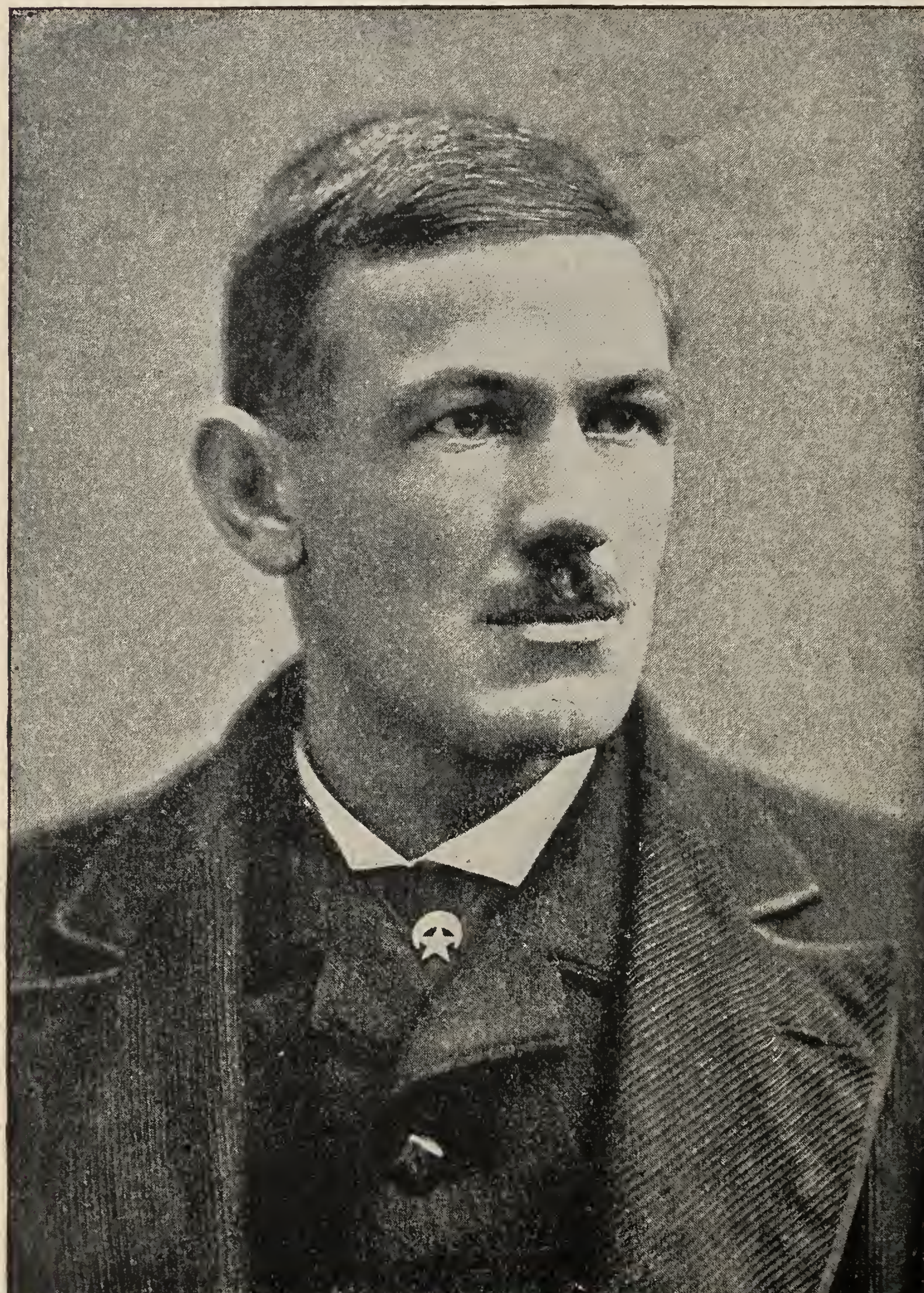
veyance, raising and distribution of water; also in the application, under peculiar circumstances, of high heads to motive power, demanding novel mechanical devices, operating under new methods that are just now the subject of interesting research. In this connection, too, is that vast field of special engineering, which has just taken a name and place as a separate and extensive branch. We allude to irrigation, or the application of water to arid soil, and to various growths thereby enabled, involving not only the physical conditions of collecting, conveying and distributing the life-giving element, but also its effects upon the soil and the chemical problems that require the consideration of the irrigation engineer.

In the same connection again is the variation of precipitation, and the physical phenomena that attend a difference therein, which is as three to sixty in a distance of one thousand miles of the coast line, causing characteristics of streams, growths and climate that afford an endless opportunity for technical research.

In the way of natural phenomena this country abounds with strange and fascinating curiosities, presenting chemical and geological problems that invite thought and careful study. Hundreds of thermal springs from 60 to 212 degrees, and in some cases above the boiling point, giving off vapor here and laden with mineral there, are found in many parts of our Coast, in regions that are as wild and romantic as they are picturesque.

The problems of subterranean water in the gravel strata of sedimentary lands, and the artesian basins of wonderful extent, also furnish to the engineer and geologist problems of not only scientific interest, but also intimately connected with the value of land, and the prosperity of important industries depending on subterranean water supply.

The approaches from the sea and the accessibility of the Coast to shipping, the safety of the principal coast harbors, and the navigability of the rivers, for the purpose of water traffic, are special fields in which the Pacific Coast engineer will find ample opportunity to exhibit his skill and knowledge. The time is near when the question of coast harbors will be a very material one to the interests of our States, and with it the improvements of the navigable rivers will go hand in hand. Opportunities are offered for original research in this field, which cannot be exceeded anywhere in the world. The successful drainage of the great Sacramento Valley alone suggests a vast problem, which has become a most vital and important one to a wealthy and prosperous population of farmers



OTTO VON GELDERN, C. E.

SECRETARY OF THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

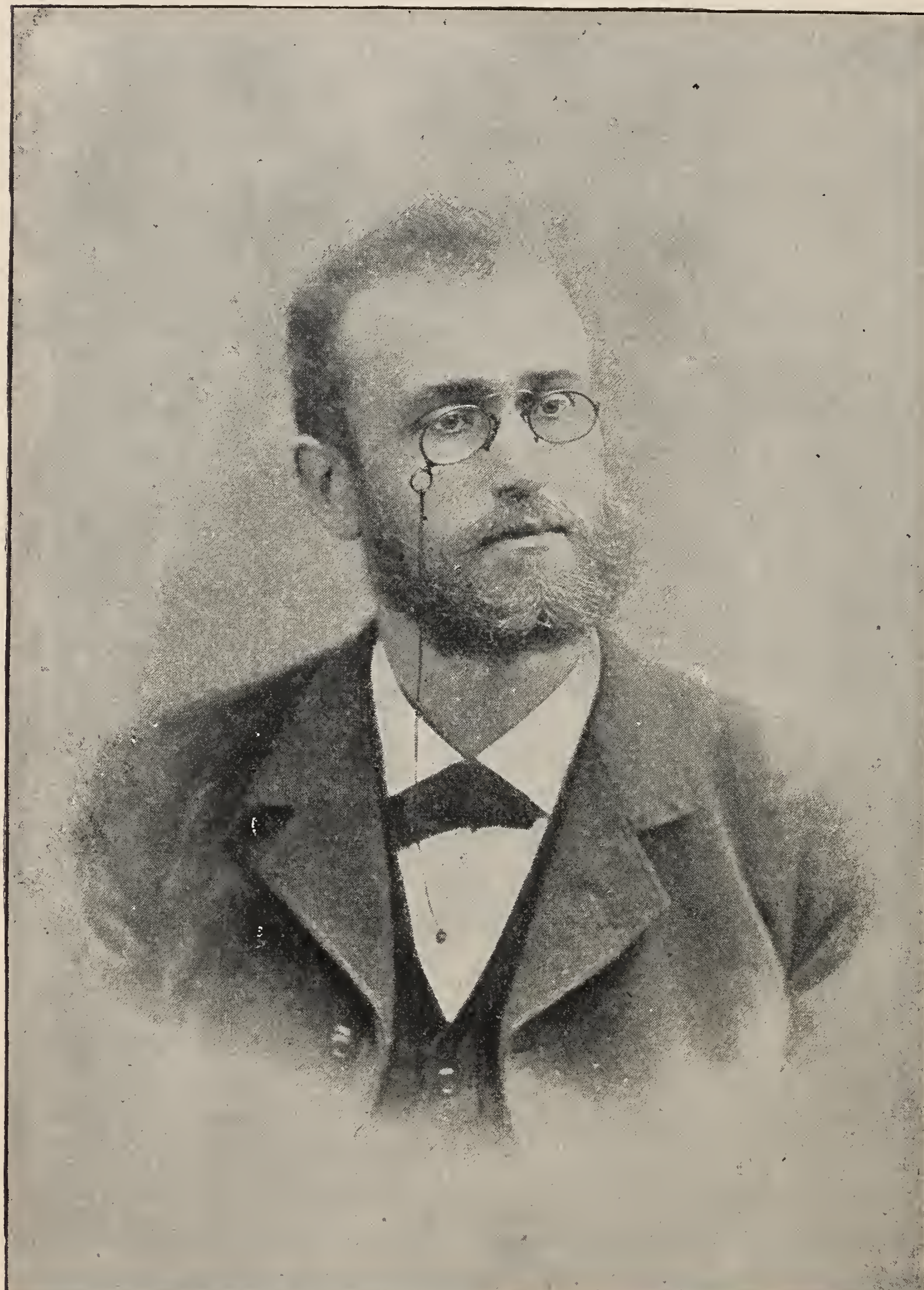
and horticulturists. Directly connected with this problem is the successful restraint of mining debris, a question which is still awaiting its practical solution, and to which many intelligent and industrious communities, scattered throughout the Sierras, are looking with an unabated interest. There is work to do, and enough of it; work that will bring manifold reward to the engineer who is called upon to battle with this one great problem alone.

The improvement of harbors and rivers, and the light-house service of the Coast, are works in the hands of the Government, executed mainly by the corps of engineers. Prominent in this particular branch of the technical profession is Colonel George H. Mendell, of the engineer corps, the first President of the Technical Society, a gentleman who has been for many years closely identified with all the noteworthy engineering problems of the country. Allied to the improvements of the harbors is their proper defense, a subject that is certain to have the fullest attention of the army engineers in the near future.

The mechanic arts of the Coast are extensive and diversified. The machine works, of which there are a great number, employ a large corps of draughtsmen and intelligent designers to prepare what has been ordered today and what will be required tomorrow. These are engineering establishments in the full sense of the term, where contracts for work of any kind are entered into irrespective of patterns, drawings, or precedents in the same line. One may order, in any of the principal works, a locomotive, a steamship, the frame work of a twelve-story building, a steam plow, or a ton of bridge bolts, and the work will be done. The methods are, in many respects advanced, and the versatility of the practice offers a fine field for students and apprentices.

The building of the *Charleston*, *San Francisco*, *Monterey*, and *Oregon* for the U. S. Navy, the *Peru* and other merchant steamers of a high class, indicate what exists in the line of marine engineering and shipbuilding. The ponderous plants of the Comstock mines, of which a single pumping engine cost a quarter of a million dollars; the wonderful and nowhere equaled system of urban cable railways; the extensive manufacture of high explosives, and numerous other industrial articles, manufactured on a larger or smaller scale, attest that we have a claim for diversity.

Turning now to the learned societies and professions, we find on the Pacific Coast a full measure, and a record that needs no explanation here. In geology, astronomy, geography, history, electrical



GEO. J. SPECHT, C. E.

FIRST VICE-PRESIDENT OF THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

technology, chemistry, and pure science, there are the contributions that naturally arise among a cosmopolitan population. From these redundant sources is drawn the membership of the Technical Society.

The most marked feature of the Society's work, aside from its great diversity, is the unusual harmony of its conduct and the good feeling engendered among its members. Our account of it would be incomplete without reference to this fact. This is the main secret of the Association's progress and stability, which is not always the case with similar organizations in this country.

If the recent progress goes on unabated, there is every reason to believe that the Technical Society will become a factor in our commonwealth, that its influence will be felt in all the engineering enterprises of the country, and that by its advice, the commercial interests of the Pacific Coast, will, in a measure be guided and properly advanced. The necessity for such an active organization is obvious, and as the Society prospers and advances, its standing in the community and its opinions will grow in importance and popular value.

Such a future existence of usefulness was the ideal held in view by the founders of the organization, and in that direction every effort has been made by those who have had its management in hand.

One of the most active of its organizers was the first Vice-President of the Society, the late Geo. J. Specht, Civil Engineer, who gave a great deal of his time and attention, in the most unselfish way, to further the prosperity of the Association. His death, in 1888, was a most unfortunate occurrence for the organization. It happened at a time when the first enthusiasm of the members had somewhat cooled, and when it required a self-sacrificing energy to continue and carry on the work against a general apathy. He was born in Holstein, Germany, in 1851, and graduated at the gymnasium of that place. After serving with the German army and participating in the Franco-Prussian war, he began his studies in civil engineering, graduating at the polytechnic school of Gratz, in 1874. His professional practice was on the Austrian railways, having been connected with the Crown Prince Rudolph railway in 1875, and with the Gotthard railway in Switzerland, until February 1877, when he came to California. On the Pacific Coast he entered private practice, having located at San Francisco, and soon became permanently connected with a number of engineering works.

His death was certainly an irreparable loss to the Association. But his memory is still cherished and held most dear ; the work of the Technical Society and its mission, having been taken up as an inheritance from the man who had labored so faithfully in shaping a course to be pursued, but who had to leave his task undone and submit it to the hands of others.

Prominent among the members, are the past officers of the Society, who have contributed cheerfully to its welfare. Of these we may mention Colonel Geo. H. Mendell, Corps of Engineers, U. S. Army, in charge of the Pacific Coast Harbor Works, the first President ; Chas. G. Yale, the first Secretary; Marsden Manson, past President ; and many others who have served faithfully in various offices that the Society bestowed upon them.

But the most energetic of members, to whose activity and earnestness of purpose the recent remarkable progress of the Technical Society is almost entirely due, is Mr. John Richards, a mechanical engineer of wide reputation and unusual skill, who has been its President since 1889. He is the most zealous in every way, not only in the management of the affairs of the organization and in his prescribed duties as President, but also in his individual contact with members, in his advice in matters of mechanical engineering, and his literary contributions to the Society's publications. A number of valuable papers testify not only to his ability as a writer and to his mechanical knowledge, but to his ever-ready hand to promote the interests of all. One of the most interesting papers and perhaps the most valuable that the Society possesses, is his "Abrasive Processes in the Mechanic Arts," published in the Transactions of 1891, which, in its conciseness and clearness of language, and the interesting manner of imparting valuable information, of which so little is generally known, may be justly called classic. This paper was widely circulated and read with unusual interest.

EXTRACTS FROM A NOTEBOOK.

[BY "TECHNO."]

No. XIX

BELGIANS, WALLOONS, FLEMISH AND DUTCH.—— FRANCS AND FLORINS. BRITISH BELGIUM.—— THE GIANT ANTIGONUS.

——————Much to my pleasure, and most unexpectedly, my Uncle consented to go through Belgium on our way to England. It is not much of a diversion, because from Holland it is but a step across an imaginary line set up within the memory of living people. It is in fact on the way to England, and is in some respects the most notable little country in the world, filled with manufactories, progressive, intelligent, quiet, and next to England and portions of France, with the greatest natural resources that exist in any part of Europe.

These notes, not being a journal, traveler's guide, or extracts from an encyclopedia, I will not trouble the reader with the guide book matter, and not much with my own ideas, because of all places we have visited thus far, my Uncle seems more at home here. He was sour and taciturn from the time he paid the hotel account at Rotterdam, until we crossed the line, and then came a change; he was contented and in good spirits.

"Now" said he, "we will use francs instead of florins, and get more for them, besides we can devote our energies to seeing and thinking instead of contriving how to avoid being cheated. I gave you a lecture on this subject in Sweden, here is another example, less marked however."

"Belgium" said he, "is a queer country to Americans. You see those Walloons out there, spading the earth instead of plowing it. Our people would call that stupidity; perhaps it is; perhaps again it is not. Depends on circumstances; by the way, I think you have noted down somewhere in that note book of yours, that particulars are not much considered in studying a country. It is generals, that must be relied upon. In this case there is the value of the ground or the area available, the climate, nature of the soil, nature of the crop, and nature of the people, to be considered, perhaps a spade is the best implement.

Taking into account standards of honesty, personal rights, happiness, and contentment, our modern high-pressure civilization with its realistic ends, is a humbug. Here in this British country, the Flemish, French, Walloons and Dutch all mixed together, the most mongrel population in Europe, go on quietly together unless disturbed by nations outside that come here to fight."

I interrupted my Uncle to say that it was not a British country, and this set him off on one of the most emphatic addresses of our whole journey. "Not British!" said he, "Never mind how it is written down, it *is* British, more British than Ireland, guide books or any other book to the contrary. It was set up here and is maintained as a British outpost on the Continent. This is the cockpit of Europe. Look into your histories and see the carnage and throat cutting that has occured in this little country. Yes it is British in as complete a sense as any colonial dependency of that empire is, only more so, because it lies within absolute military grasp and control. In any European war in which England has a part, the first movement would be a race to Belgium, but not with equal chances, England is there now. Look away off there at those nice green hillocks that resemble the aboriginal mounds in Ohio. Those are fortifications — terrible fortifications, with bomb proofs, magazines, earth works, and the rest of it; two lines around Antwerp, inland!"

"To defend the City; against whom; the Belgians?"

"There are two lines of these forts, the same as around Paris, and about as strong, all built with British money, set up in order ready for immediate use, only sixteen hours from Woolwich Arsenel, five hours in the Thames, six hours at sea, and five hours in the Scheldt, and here could be landed a hundred thousand men in thirty-six hour's time, and a quarter of a million in sixty hours, and half a million in four day's time. Where will all these men come from? I will tell you at a future time. They are all ready. Tomorrow I will show you on the bank of the Scheldt rows of warehouses, iron shuttered, silent and empty! Yes empty! These are to hold munitions of war discharged from steamers alongside, sixteen hours out from Woolwich Arsenal. These matters are not understood in England even, and you may wonder how I should understand them. You need not worry about the authority. Open your eyes, look about, and after a good dinner that will cost only two francs, sit down and read the genesis of this little country of Belgé, with an "um" to it in our language.

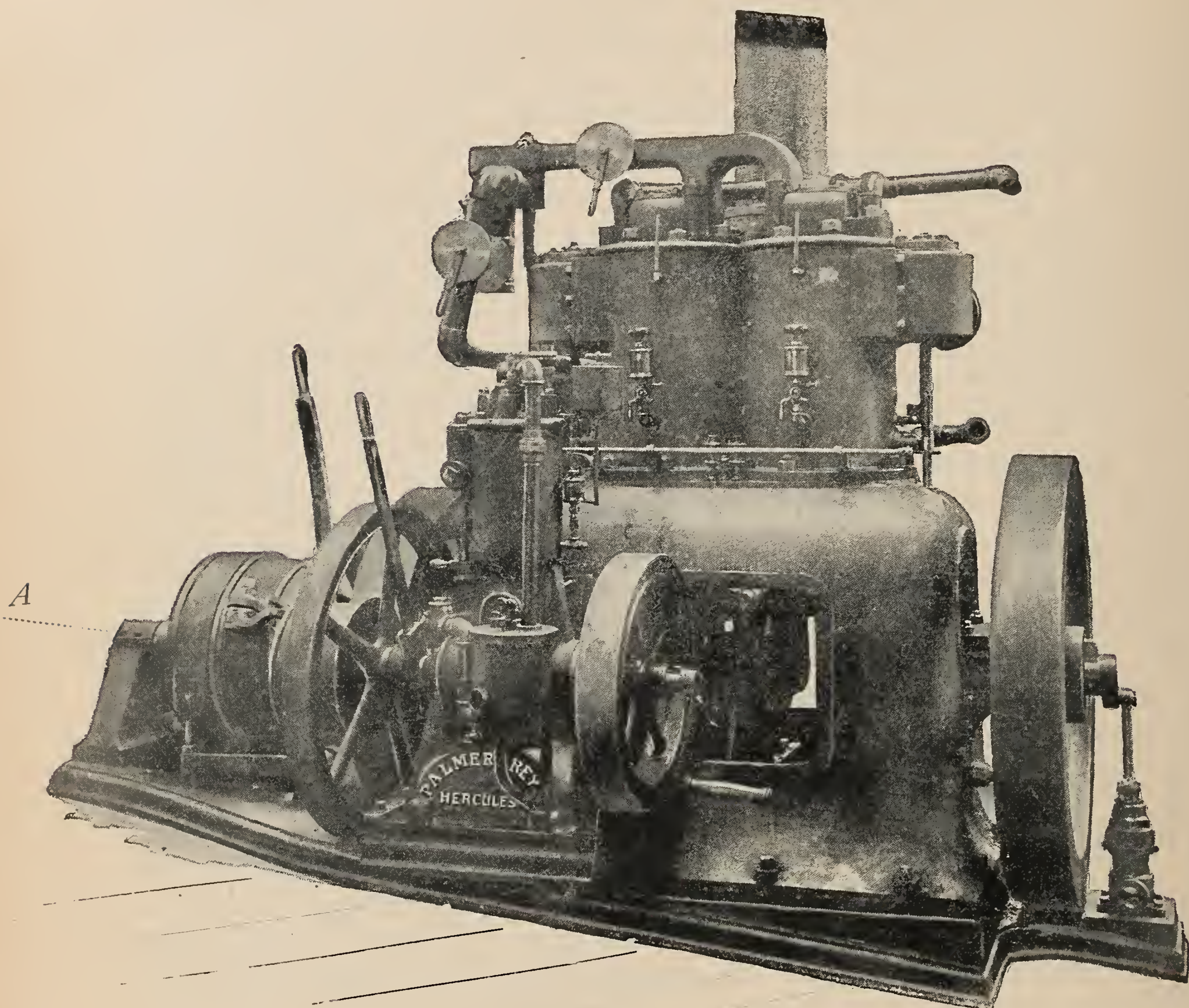
This town of Antwerp we are now entering is unknown by that name to the citizens. It is "Anvers." Antwerp is an old Dutch name derived from a legend of the giant Antigonus who lived about here and exacted toll from all water craft ascending the Scheldt. If tribute was refused, he cut off the skipper's right hand and threw it over a wall, saying, 'there shall arise a city from these hands'—hence, Ant–werp—'ant,' hand, and 'werp' or 'werpen' to throw, hence 'Antwerp' or hand throw. Silly, you say. It is, surely, but whoever could fathom Dutch traditions and fancies? The name is 'Anvers.' 'Ghent' is 'Gand,' and so on."

——————We are now in this famous old town, curious in all ways, from the images of saints that guard the street corners, to galleries of famous paintings, Flemish, Dutch and French, a very modern zoological garden and menagerie. Piles on piles—acres one might say—of American bacon on its way to German mastication. Ships unloading petroleum from America, and for a wonder, here and there with the stars and stripes at the peak. It is a combination of Dutch stolidity, Flemish fancy, French customs, and intense commerce. I found the warehouses my Uncle mentioned, but was skeptical about the half a million of soldiers from Great Britain, and so reminded him after dinner of his promise to explain this matter further.

"There are" said he, "a million of trained volunteers in England. Not men who train a couple of days in the year with bean poles for guns, but well drilled men who spend two weeks or more in the field each year, well armed, picked, and effective. They are homeguards as our own volunteer companies are, but if these men were wanted at Antwerp the home service rule would not apply to one man in a hundred. I need not go into this matter in detail, my views are not to be thrust upon any one, not even those concerning Belgium, but just wait until a war comes involving Great Britain and see how far I am correct."

——————The more I see of the position that Great Britain holds among the powers of Europe the more I am convinced that there are here two policies, and in effect two governments, one a newspaper one, heralded over the world and the subject of political wrangles at home. The other a deep secret policy guided by and known only to a few of the wisest men; reaching into the whole world and into the future, taking cognizance of what will probably be fifty or even a hundred years hence, a national policy without political creed, not understood by her own people and much less by other people. In proof of this let one imagine the affairs of an empire of 325 millions of people, scattered all over the world, composed of various nations and embodying military and commercial problems that in the houses of parliament would be understood about as much as the precession of the equinoxes would be.

(*To be Continued.*)



ENGINES OF THE "HIRAM BINGHAM."
MESSRS. PALMER & REY, SAN FRANCISCO.

THE "HIRAM BINGHAM."

The *Hiram Bingham*, a vessel 50 feet long, 14 feet beam, fitted with full schooner rig, and also with gasoline engines of 25 horse power, by Messrs. Palmer & Rey, of this City, left here on the 31st of October for the Gilbert Islands, via. Honolulu. We were out on one of the trial trips of this strange vessel, and must confess to a modification of some previous views respecting propulsion by engines of the kind for boats of this size. Their performance was admirable, driving the schooner at ten miles an hour without the least hitch of any kind, and running with a steadiness that could not be exceeded by a steam engine. As may be seen from the plate above, made from a photograph of the *Bingham's* engines, the proportions, and all their connected gearing, is much heavier and stronger than is employed for stationary work, and so made in view of use in a distant land where there are no facilities for repairing, and not much for maintenance and care.

The engines were tested by Chief Engineer Kontz, U. S. N., at the works of Messrs. Palmer & Rey, and gave out over 31 horse power, or 24 per cent. more than the power contracted for. They were managed on the trial trips by the Rev. Mr. Walkup, who is to take the vessel out to the Gilbert Islands, where he will employ her for missionary purposes.

It is a most remarkable adventure in several ways. The Rev. Mr. Walkup has a scientific turn, and holds his certificate as a navigator, but to start across thousands of miles of wide ocean in a craft of this size with a crew of three persons, a Swedish mate and two natives of the Gilbert Islands, seems a remarkable venture, which we hope will turn out successful. At sea the sails alone will be used, unless in the case of a calm, the screw being disengaged so it will revolve free. There is fuel enough provided for emergencies, and a fresh supply will be taken in at Honolulu, if the vessel gets there.

CLIMATIC FEATURES OF THE PACIFIC SLOPE.*

ESPECIALLY CALIFORNIA, AND THEIR RELATION TO ATMOSPHERIC CONDITIONS OVER THE PLATEAU REGIONS.

By Lieutenant John P. Finley, U. S. Army.

The weather of any place is the sum of its transient meteorological phenomena. To find the sum of such occurrences in California will require more than ordinary calculation. In other words there is variety in her weather as there is diversity in her industries. To understand these varying conditions one must consider, at least, the following important general features: (1) The great extent of latitude embraced by the State. (2) Its pronounced topographic outlines. (3) Its position relative to the North Pacific Cyclone Belt. (4) Its relation to the Japan and Alaskan currents of the North Pacific.

To comprehend the meteorology of such a region one must become impressed with the necessity of extending the investigation far beyond the limits of the State. Surrounding atmospheric

*Read before the Technical Society of the Pacific Coast, Nov. 4, 1892. Reprinted by permission conditions for hundreds of miles must be closely watched to discover the source of those phases of cloud and sky which indicate the progress of peculiar systems of circulating air, under the influence of solar radiation and of the axial rotation of the earth, and which bring over large areas of country, changes in temperature and variations of precipitation affecting the prosperity of thousands of square miles of territory. One cannot study weather understandingly from his own doorstep.

Because of California's great extent of territory north and south she feels the effect of tropical influences as well as those of the temperate zone. Coupled with her varied topography, unequaled in the United States, the fluctuations of atmospheric pressure within the limits of the North Pacific Cyclone Belt give rise to some anomalies in weather, both extremely interesting and complicated. Why wonder at the results, with a surface contour affording extraordinary differences in elevation, from nearly 300 feet below to about 15,000 feet above sea level, permitting variations in temperature from torrid heat to Arctic cold, and changes in atmospheric humidity, from the driest areas on the continent to the saturation of a tropical clime. The most skilled meteorologist will find ample scope for the exercise of his knowledge and professional training.

Being at one season largely within and at another largely without the predominating influence of cyclonic disturbances, introduces peculiarities of weather and climate which distinguishes the meteorology of California from that of any other portion of the United States.

The proximity of two ocean currents essentially different as to temperature, course of movement and atmospheric effect, gives rise to a coast climate remarkably at variance with that of the interior valleys only a few miles away, and still different from the adjacent mountain districts. No state in the Union is so uniquely situated, so diversified as to climate and weather within such circumscribed limits.

All the various local and secondary causes are largely subservient to one superior and overwhelming influence, the action of the North Pacific Cyclone Belt.

The meteorology of the State as a whole, as well as of localities, falls under the sway of this power. The notion must be discarded, that the weather of California is not dependent upon atmospheric conditions over adjacent regions to great distances, especially over states to the east and north. This dependence arises from the fact that these adjacent states are nearer and therefore more strongly affected by the passage of cyclonic disturbances. All of these disturbances enter upon the coast from the North Pacific Ocean. They are huge atmospheric eddies which have developed in the air resting upon the warm waters of the Japan Current. The typhoon of the China and Japan Seas becomes, later on in its course, the cyclonic disturbance which sweeps across British Columbia, thence to the region of the Great Lakes and further on to the Atlantic and Europe.

All cyclones cross the United States at a lower latitude in winter than in summer. This condition results, in part, from the apparent movement of the sun north and south of the equator, whereby the area of heat and moisture of the temperate zone reaches a higher latitude in summer and recedes to a lower latitude in winter. The atmospheric eddies enter the continent at about the 50th parallel, being about the latitude of the center of the northern portion of the Japan Current, which flows eastward from the Asiatic Coast. The fluctuations of the Cyclone Belt north and south on the Pacific Coast depends then upon the change in the location of the areas of heat and moisture. These two elements constitute the food of cyclonic disturbances, and without an almost unlimited source of supply areas of low barometric pressure begin to fill up and disappear. Clouds and rain, with boisterous winds, are soon followed by clear, calm weather and a dry, cool atmosphere.

To understand the distribution of precipitation over any region one must clearly comprehend the essential characteristics of a cyclonic disturbance. Such information is especially necessary regarding the rainfall in California, for its occurrence and distribution are peculiar and unlike, in some respects, that of any other state.

As cyclonic disturbances may vary in diameter from 500 to 1,500 miles, and the centers invariably move eastward, north of San Francisco, it would rarely, if ever, occur that the whole of any area could be shown on a chart of the Pacific Slope. From the Pacific to the Mississippi Valley the direction is a little south of east. From that river to the Atlantic the course is somewhat north of east. The forms of cyclonic areas are either elliptical or circular, and the former predominates on the Pacific Coast. The isobaric line of 30.00 inches marks the separation between the two principal classes of atmospheric disturbances, viz., the cyclone (low), and the anticyclone (high).

An observant "new arrival" is not long in discovering that California has, during the year, two weather periods instead of four, known as the "wet season" and the "dry season." He learns that they are powerful factors in determining the prosperity of the commonwealth. When Nature, in a kind mood, arranges the relation of these two seasons with a marked uniformity of variations, then Dame Fortune smiles upon the commercial and agricultural interests of the State. If the exact character of these seasons could be forecasted in advance, what enormous profits could be realized. Such long-range prognostications have never been vouchsafed to man, and there is no immediate prospect of his acquiring such extraordinary knowledge. We must be content, for the present at least, with a much more limited degree of information, but yet not lacking in practical importance.

The two meteorological seasons of California are dependent for their proximate occurrence upon the distribution and frequency of cyclonic disturbances between the 40th and 50th parallels, and the rate of progress eastward, together with the energy displayed between the Pacific Ocean and the 100th meridian. In short, the cyclones move farther south and are of greater energy in winter (the wet season) than in summer (the dry season). A careful examination of the charts in the office of the Weather Bureau will show very clearly that the weather over any region depends upon the relation of the latter to the quadrants of the passing cyclone or anti-cyclonic disturbance. According to the quadrants which pass over any region, so will be the successive phases of weather therein.

All forms of atmospheric precipitation are distributed over the earth through the agency of these systems of air circulation. They are of enormous extent and great power, drawing moisture from all available sources, carrying it to great heights in the atmosphere, where, by a marked change in its surroundings, the vapor is transformed into water, and falls again upon the earth. The physical forces of evaporation and condensation cannot fulfill their mission in the production of atmospheric precipitation without the assistance of adequate means for setting up and maintaining a system of circulation for the distribution of the vapor of water throughout the lower regions of the atmosphere.

It has been found that these atmospheric eddies pursue certain paths over the continent of North America. There are two such lines of travel, one along the northern boundary of the United States, and the other from the West Indies northwestward to the Gulf States, curving northward at the 30th parallel of north latitude, and moving thence northeastward over the Atlantic Coast

States. The second path joins with the first one near Nova Scotia; where, together, they form a well-beaten path along the 45th parallel, of all cyclonic disturbances crossing to Europe.

It is a fact to which attention has not been especially drawn, that that portion of the United States most distant from the influence of the atmospheric eddies, which travel the two storm paths, embraces the arid section, or what is known as the middle and southern plateau regions. They include southeastern California, Nevada, Utah, Arizona, New Mexico, western Colorado, and southern Wyoming. This may be called the dry region of the United States. It is well known as the region of least rainfall, and has been found to be the region over which the greatest atmospheric evaporation (about 100 inches annually) takes place. There can be no doubt that the meteorology and climatology of this region depends most largely upon its geographical position regarding the cyclonic belts over the United States. California's share in this relationship cannot be understood without a comprehensive and graphic view of the whole situation.

We must already begin to see some evidence of the preponderating influence of the northern storm belt in the distribution of precipitation over the United States, and especially the Pacific Slope. Of course all general and predominating influences are counteracted here and there by local differences, which, in this discussion, may be briefly referred to as topographical. The limits of this paper will not permit of considering this branch of the subject particularly. The dry region of the United States can never be other than it is, so far as atmospheric conditions are concerned, without a great physical change, which would completely reverse the circulation of the Japan Current in the North Pacific Ocean, and bring it nearer the California Coast. It must needs bathe this Coast as does the Gulf Stream the coast of the South and Middle Atlantic States. Then would the dry region become, in weather and climate, and in vegetation, as that of the Gulf and South Atlantic States.

We find that the weather of California, like that of any other region, is dependent upon the atmospheric conditions surrounding it for hundreds of miles. If it were nearer the cyclone belts, its two famous seasons, the "wet" and the "dry," would be changed into a more uniform distribution of precipitation throughout the year, and a less uniform distribution of temperature. Such a modification of its climate would be detrimental to some of California's greatest industrial pursuits. Its variety of weather and climate is now unrivaled in the United States, and therefore the peculiar adaptability of the State for the growth of the choicest fruits, grasses and cereals. Its geographical position is such that the seasonal fluctuation of the North Pacific Cyclone Belt carries the rain area far to the north, and protects the crops that would otherwise suffer severely from heavy cloudiness and drenching rains.

The precipitation of the "wet season," when the Cyclone Belt takes a more southerly course, is generally heavy; and there is stored in the earth a supply of moisture that frequently goes far towards supplying the needs of summer. When this source fails, resort must be had to either surface or sub-irrigation, but the "dry season" in California does not mean an entire absence of rain throughout the entire state. Rains occur on the northwest coast from San Francisco northward, and in the mountains in the northeast and southeast portions during the summer. They are frequently heavy with thunder storms in the southeast portion. The central valleys are the dryest in summer, especially in July and August, where in some places no rain falls during those months for a period of several years. In any case only the lightest showers occur at long intervals, resulting from the drifting over and settling down into the valleys of heavy clouds from the mountains. Such precipitation is likely to occur when the snows of the previous winter have been heavy and the mountains remain snow-capped throughout the year.

The heaviest precipitation occurs in the mountains, diminishing rapidly to the valleys, and becoming least on the Mojave and Colorado deserts. The average depth of snowfall in the mountain districts is a very important factor in forecasting the rains for July and August, and ascertaining the probable water supply for irrigating purposes. Heavy snow in the mountains in winter will result in "cloud bursts" in the high plateaus in summer. The enormous extent of surface covered with snow, from a few inches to many feet in depth, offers an extraordinary opportunity for rapid evaporation under the burning rays of the morning sun, through a clear, crisp atmosphere. Heavy clouds appear over the lofty ranges by about 12 noon, and when the sun begins his downward course, and the air currents are pushing down the mountain, great masses of clouds are hurled together and carried over the valleys, attended by smart showers and occasional manifestations of atmospheric electricity. Here we have a brief view of the conditions under which summer rains occur in the mountain districts of California, especially in the southeastern portion of the state, and the adjacent regions of Nevada and Arizona. Even these may be called cyclonic rains, for they invariably occur under the influence of a barometic trough of low pressure, covering the eastern portion of the Pacific States and the plateau regions, the center of the cyclonic disturbance being in British Columbia, north of Montana. The effect of this trough may not disappear until the central area moves eastward into Dakota and Minnesota, like a monstrous sea serpent slowly dragging his tail.

A low barometic pressure is especially favorable to evaporation and the development of ascensional air currents, which force great quantities of vapor of water into the air, and rapidly condense it into clouds. Clouds consist of small drops of water, light enough to float in the air. Fogs are clouds resting upon or very near to the surface of the earth. When the drops of water become large enough and sufficiently heavy to fall to the earth they are called, collectively, rain. I have quickly depicted here the transitions from water, in the liquid and solid state, through the vapor or gaseous form, to the liquid state again. What a powerful engine is the atmosphere, and how nicely adjusted must be all the cogs, wheels, springs and compensations of this exquisite piece of machinery that it never wears out nor breaks down, nor fails to do its work at the right time and in the right way.

The effect of the fluctuation of the North Pacific Cyclone Belt is also shown in the probability of rainy days for various parts of the State, and in the percentage of clear and cloudy days. The probability of rain for the valleys is proportionately much lower in summer than the probability of cloud formation. This is largely due to the fact that while the northward deflection of the Cyclone Belt is sufficient to prevent rain it does not remove the influence of cyclonic circulation in the production of cloud formation. At times the sky will remain overcast for several days and pass away without precipitation. The condensation has not been sufficiently vigorous under cyclonic circulation to develop drops of water of sufficient size to fall to the earth.

Tabulated statistics furnish interesting and valuable data for comparative climatic study, and show the importance of systematic meteorological investigation. The public generally are not able to realize the vast amount of labor in computations, and the long years of constant watching, secretly represented by a little collection of figures. It is a patient but determined study of Nature, who refuses to reveal herself without the most ingenious and prolonged effort of man.

No portion of the United States offers richer opportunities for meteorological research, or will afford greater practical results from thorough and systematic investigation, than the weather and climate of California. No state is in greater need of such scientific inquiry; and if successfully prosecuted it will greatly aid in the development of her rich resources. It will bring them to the attention of thousands who would be glad to enjoy the fruits of "perpetual summer;" the opportunities of a wonderfully varied climate and soil; the invigorating influence of unsurpassed mountain and air scenery; and the advantages of marked uniformity of temperature along a coast line of marvelous extent and diversity.

Theoretically California should furnish the best and most varied health resorts and sanitariums in the United States. Within her borders most every form of wasting disease should find the means of temporary, if not permanent, relief. While our present knowledge warrants this assumption, yet practically the truth of this statement in all necessary details must be developed and tested by adequate scientific research.

The agricultural, horticultural and commercial interests must be more fully informed as to the probabilities before them, and every line of industry afforded the means of weighing thoroughly its chances for growth and success. A reliable knowledge of probable weather changes and climatic effects is rapidly becoming a daily necessity in all occupations.

THE FLOW OF WATER IN PIPES.

Some time ago *Engineering*, London, published the following in respect to a short method of determining the flow of water in pipes at an assumed velocity of three feet a second:

"Many formulæ have been devised by various engineers for expressing the relation between the velocity of flow in a pipe and the head required to produce it. Unfortunately all of them are complicated, and cannot be used for mental calculation or in making rapid approximations. It may be noted, however, that in a vast majority of cases arising in practice, the velocity of flow lies between 2 feet and 4 feet per second, and on an average is 3 feet per second. The head required to maintain this latter velocity through a length of clean cast-iron pipe is then

$$\text{Head in feet} = \frac{\text{Length of pipe in feet.}}{25 \times \text{diameter of pipe in inches.}}$$

and the discharge in cubic feet per minute is very nearly equal to the square of the diameter of the pipe in inches, the error being under

2 per cent. in excess. Both these calculations are easily performed mentally. For a velocity of 1 foot per second less than 3 feet per second, the head must be reduced one half, and by a proportionate amount for intermediate cases. For a velocity of 1 foot per second more than three feet per second, the head must be increased by .7 times that required for a 3-foot velocity, and that required for intermediate cases can again be determined by adding a proportionate amount for that required for the 1-foot increase. In this way the head required to maintain through a clean cast-iron pipe a velocity of not less than 2 feet a second, nor more than 4 feet a second, which are the limits usually adopted in practice, can be determined mentally with an accuracy sufficient for 99 per cent. of the cases that arise in an engineer's practice. Having the discharge at a velocity of 3 feet a second it is of course easy to obtain the discharge at any other velocity."

The *Compass*, New York, republishes the above, and the Editor adds as follows:

"We have frequently used the following original formula and found it to give results almost identical to those obtained by Weisbach's, while it has the merit of being very much simpler.

$$\text{Loss of Head in feet} = \frac{L}{120\ d} \times \left\{ \frac{v^2 + v}{2.5} + \frac{v-2}{10} \right\}$$

where L = length of pipe in feet
d = Diameter of pipe in inches
v = Velocity in feet per second.

Example—Find the loss of head for 400 feet of 12 inch pipe, the velocity being 3 feet per second.

$$\text{Loss of Head} = \frac{400}{120 \times 12} \times \left\{ \frac{12}{2.5} + .1 \right\} = 1.36 \text{ feet.}$$

which is the same as Weisbach's, while *Engineering's* formula gives

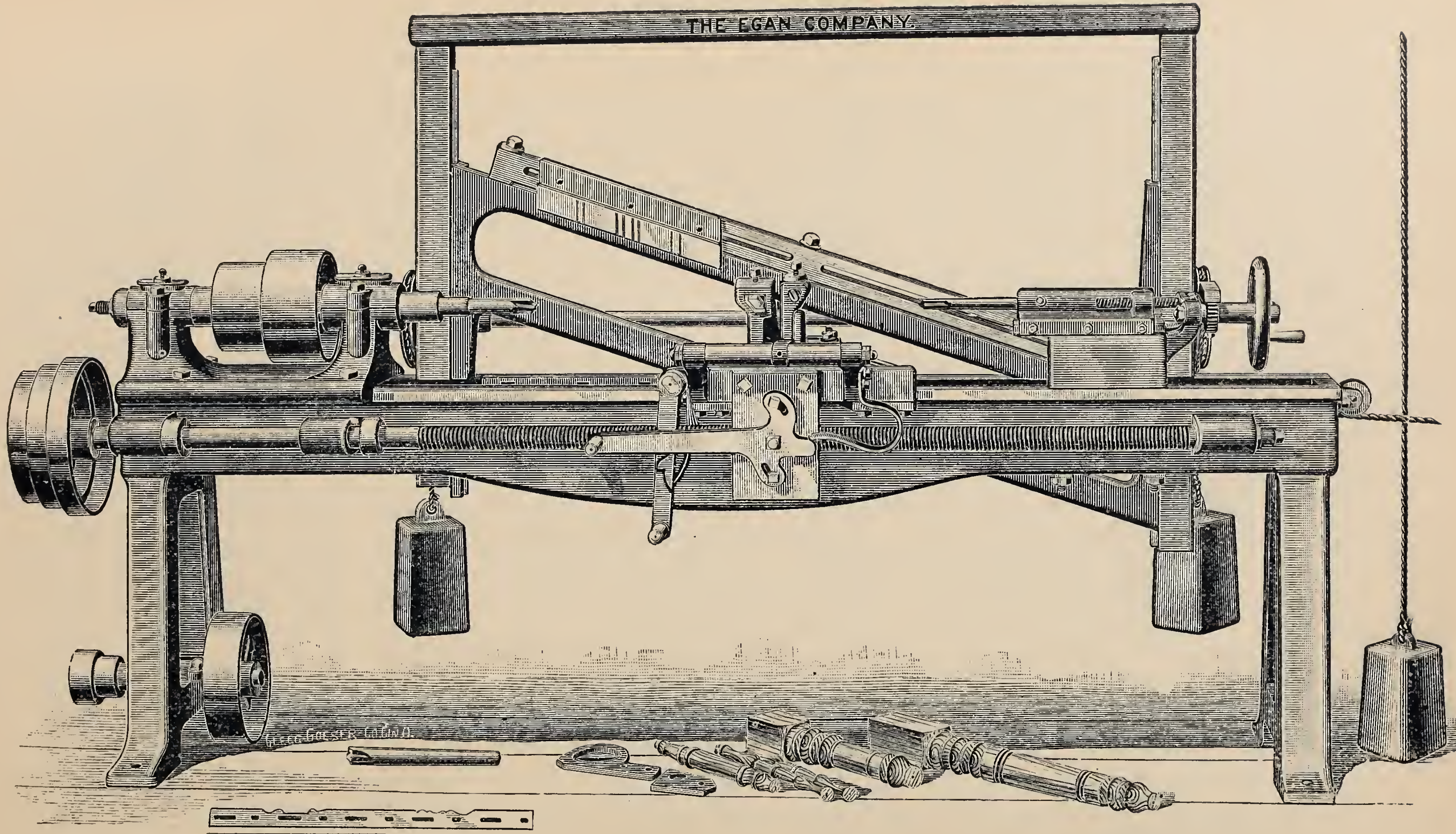
$$\text{Loss of Head} = \frac{400}{25 \times 12} = 1.33 \text{ feet.}$$

Weisbach's formula is very frequently used, we believe, by hydraulic engineers in this country, and in some cases where riveted pipes are employed, 20 per cent. is added on, so that the formula then becomes

$$\text{Loss of Head} = \frac{L}{100\ d} \times \left\{ \frac{v^2+v}{2.5} + \frac{v-2}{10} \right\}$$

We submit to our readers *Engineering's* formula and our own (which we must say is an empirical one) in the hope that they may be sometimes found to assist speedy calculation."

The principal difficulty met with in considering the capacity of pipes is the variation in assumed velocities. In common practice this varies from 2 to 20 feet a second, so a constant, based on given velocity 25 *D.*, as in the formula first given, for example, is not of much use except for service mains in flat countries.



Automatic Gauge Lathe.—The Egan Company, Cincinnati, Ohio.

AUTOMATIC GAUGE LATHE.

THE EAGAN COMPANY, CINCINNATI, OHIO.

The lathes, of which the drawing opposite is a type, called "gauge lathes" with finishing or shear knives, have been added to the large list of machines made by the Egan Company, and are carried out in a very substantial form.

These lathes have been sparingly made in this country, and as we may say, not at all in any other country, one reason being that they require an accuracy not easily attained in ordinary machine shops, and another, that this method of turning is not very well understood. The alignment of the spindles requires equal, if not more precision than an engine lathe, because the latter may operate when not quite true, but a gauge lathe will not.

The overhang of the centers, as may be seen in the drawing, is at least five times as much as in common lathes. Both centers run at a high rate of speed under an end pressure of from 200 to 1,000 pounds. The rear center has a long gun-metal bearing moved on a slide, and must be bored and maintained, as before said, in precise alignment with the main spindle, so the sharp parts will coincide.

The slide carriage is provided with a fixed gauge tool that reduces the piece to cylindrical form so it will fit a ring die on the rest. Following this is an adjustable cutting tool that will give a taper or other form not too irregular, by means of a pattern, and finishing is done by the diagonal profile knife behind, which comes down automatically as the slide-rest passes on out of the way, cutting beads, covers, balls, or almost any of the well-known patterns for cabinet turning.

The action of these finishing knives is the same as a hand chisel, and the wood is left perfectly smooth. As the slide-rest runs back, the diagonal finishing knife behind rises automatically, being balanced by weights at each end as shown in the drawing. The face of these finishing knives is made of a form to fit one side of the pieces to be turned, and are expensive to make, but when once prepared can be used for years without much wear.

We are describing these lathes as though they were unknown on this Coast, which is no doubt the case, because some years ago there was a company organized and some money wasted here in attempting to turn ballusters and similar work by means of a revolving cylinder provided with a series of shape knives, the wood having a slow rotation about its own axis, and the tools advanced laterally as the piece was reduced. The method was an old one, never successful except on green wood and stiff pieces, and it was claimed in this Journal at the time that a gauge lathe such as is here described would do more and better cylindrical work, and cost one fourth as much, but no one seemed to know what a gauge lathe was.

The scheme failed, as all must that are based on controverting old and well tried principles of operating. It is true there was an object in the polygonal section that could be made, but this is a matter of style, the cylindrical form always surviving.

These gauge lathes arranged with the shear knives, as shown, are made to turn what are called carriage spindles not more than ¼ inch in diameter at the ends, up to table legs as shown in the engraving. The finishing knives are made to a pattern, and to order.

MARINE PROPELLERS.

We have, a good many times, pointed out the fact that in the literature of propellers, if not in their mathematical treatment, the forward movement into undisturbed water was not considered, and that this was the principal fact relating to their action. Confirmation of this appears in a recent communication to the editor of the *Steamship*, by Mr. Alexander Vogelsang, a well-known writer on this subject. We append the following extracts, the italics being added :

* * * "The whole theory of 'steam lines,' and of much other generic matter relating to the dynamics of naval architecture, which have been invented by imaginative mathematicians possessing more facility in the construction of absurd equations than knowledge of the requisite experimental facts, which alone can serve as a solid basis for mathematical investigations of physical phenomena, are the merest rubbish, representing nothing as it exists in nature."

* * * "In a screw propeller the blades are set an angle to the vessel's longitudinal axis, and their thrust is oblique to this axis, or normal to their surfaces; they therefore represent coupled forces in their thrust, operating at angles to the line of the vessel's motion, and uniting their impulses in that line upon the vessel itself. The greatest impediment to motion in a vessel is at the start in overcoming the inertia of the vessel, and *at this stage the propeller will exhibit its greatest thrust.* When speed at its full velocity is established, the vessel's inertia, which resisted motion, is then subdued. The vessel is now charged with the inertia of motion, its

velocity has become natural to it, and all the propulsive power that is now required is the balancing of the subordinate impediments of the fluid resistances only, and this power is most insignificant in proportion to the actual power employed for rotating the screw. The fluid resistances are comparatively small, and the power necessary to balance them is small likewise.''

If the writer of the above will experiment with a screw in still water, and then in water moving at a velocity equal to a ship's speed, maintaining the same ''relative'' velocity of the screw in the two cases, he will, no doubt, be convinced that he has wholly mistaken the laws that govern screw propulsion ; or if he will have the engines of a vessel driven at a certain speed, ten revolutions a minute, for example, and measure the thrust, when the vessel is still; then have the engines driven at the same speed over and above the rate due to the ship's progression when she is under way, he will find out whether the greater thrust of a screw occurs in starting a ship. He will, no doubt, find that no available increment of power can over-run to that rate the normal revolutions of a screw due to its progression, and that the thrust in still water, or when a vessel is still, is so slight in proportion, as to be out of comparison altogether, also that the ''rubbish'' referred to is much more reliable than his hypothesis.

ENDURANCE OF TEMPERED STEEL.

We have on two occasions before had occasion to refer to some investigations being made, by Mr. W. A. Doble, of this City, on the endurance or resistance of tempered steel, exposed to blows, and also to the fact that the value of various implements, usually left soft at the driving ends, is much impaired by ''brooming and spawling'' under severe treatment.

Mr. Doble is a member of the A. S. M. E., and the Technical Society here, and we think when done, should tabulate completely the results of his investigations, which include not only the resistance of tools, but also microscopic investigation into the atomic structure and physical qualities of steel as affected by concussion and tempering, that will have a good deal of practical value.

He has handed us for present publication the following results from blows systematically given on the end of sections of steel bars, set in an anvil or heavy casting, the sledges being swung by men striking in time and with full force.

The fourth column relates to a degree of temper at present adopted by the A. Doble Co., as that of highest resistance, and which is not easy to define, further than it is a mean between the malleable and friable state of the steel, and belongs in what is technically called "blue tempers."

The scheme of such trials was suggested by the former rapid destruction of various implements made by the company, such as wedges, drifts, drills, chisels, and so on, due to their being frayed, split and upset at the top, also to determine the effect upon hammers and sledges as the implements struck were increased in hardness.

	Steel Forged not Tempered.	Mild Temper.	Standard Temper of Doble Co.
Size of Test Plug	$1\frac{1}{2}$ in. sq.	$1\frac{1}{2}$ in. sq.	$1\frac{1}{2}$ in. sq.
Duration of Test in hours	1	4	4
Number of Sledges	3	3	3
Weight of Sledges	10 lbs.	10 lbs.	12 lbs.
Number of Blows	5,000	19,000	19,000
Original Length	$5\frac{15}{32}$	$5\frac{7}{32}$	$5\frac{37}{64}$
Present Length	$5\frac{7}{32}$	$5\frac{2}{32}$	$5\frac{36}{64}$
Reduction in Length	$\frac{8}{32}$	$\frac{5}{32}$	$\frac{1}{64}$

REMARKS.—Steel forged not tempered, head spread to average $2\frac{1}{8}$ round. Mild temper, head spread to average $1\frac{7}{8}$ round. Standard temper of the A. Doble Co., head did not spread; apparently as good as before tested.

The faces of the striking sledges polished and the grinding marks were not obliterated. The sledges were used about 7 hours each. These pieces were forged from $1\frac{1}{2}$ in. square steel but the heads were swaged to $1\frac{1}{2}$ in. round which reduced the area subjected to the force of the blows.

MR. TOMPKINS ON COUPLINGS.

Mr. C. R. Tompkins, who seems to be a "professor of things in general" has been writing of shaft couplings, and discovers that "plate couplings," by which we infer that he means those with flanges, as there is no "plate" in the case, and says of interchangable or compression couplings, "they are more expensive, and as a rule no better or more convenient to use than plate couplings." There are also instructions given for making the latter, which disclose the fact that the writer has not been a very close student in the matter of keys and does not know the difference between a key that drives as a strut and one that holds by shearing strain, but this is a small matter compared to an ignorance of the functions of shaft couplings displayed by the remark above quoted and the context.

If Mr. Tompkins should ever engage in the manufacture of shafting, he will find out that flanges keyed to the ends of shafts and bolted together, are quite a different thing from interchangeable couplings that convert the whole to a standard manufacture instead of special machinery.

In a works where pulleys are to be added or changed, or where shafting is to be lengthened, shortened or changed, flange couplings keyed on are out of the question, except at great loss and inconvenience; moreover are not commonly employed at this day.

As to cost, the best form of interchangeable couplings, the plain clamp kind, cost less than those with flanges, and are furnished at much lower prices. The cost of making a first class clamp coupling for shafts from 2 to 3 inches diameter is less than 75 cents each, and has been reduced to less than two shillings in England.

They hold up to the full torsonial strength of shafts, and of course exceed them in strength transversely. They permit interchange, which is indespensable, and the feature which permits an organized manufacture of shafting as a specialty. We are well aware that compression couplings are made that are weaker than keyed on flanges, and in some cases with a distribution of metal that has no foundation in common sense. The clamping or compression is produced by cones that cannot in the nature of things permit adjustment by wedges, taper screws, and so on, instead of applying simple bolts directly to the purpose of compression. Any and all of them perform the interchangeable function, and that far can not be compared to fixed or special couplings that are an integral portion of the shafts to be connected. There is no comparison in the case, except as to strength, and this, as we have said, can be, and is, in many cases made equal or in excess of the shafts, as has been proved by repeated tests.

Such couplings are not new. In the works of Cail & Co., at Paris, the line shafts are connected by very good clamp couplings that have been in use for at least forty years past. We examined them in 1870, and failed to ascertain when they were first applied, but that it was at some time fifteen or twenty years before.

SUBSIDIES TO MANUFACTORIES.

When the Fulton Iron Works were considering the establishment of their plant in Oakland, it was stated that a subsidy was to be paid by the City of Oakland to induce the founding of the works there. It was not carried out however, and, as we believe, much to the advantage of the firm. The Fulton Iron Works do not need subsidizing, and the principle is one not to be encouraged.

There is always the question whether any industry worth acquiring will seek an advantage and consequent obligation such as a subsidy involves, whether it be private subscription or the more questionable method of municipal grants. In the case of Oakland, for example, there are now in that city at least one iron works, and it is to be hoped there will, in future, be a good many more. If a subsidy is paid to one, it places others at a disadvantage. The subsidy matter is a kind of economical disease. It is cumulative, and has no end. Once commenced a sense of common fairness becomes an argument for the extension of the method, and what is at first an "act of grace" will soon be demanded as a right. The City of Oakland will find more industrial property within their boundaries ten years hence by adopting some ordinances of a general nature affecting all manufacturing enterprises there.

If, for example, they exempt the buildings and implements of such works from municipal taxation, the effect would be to draw industry of all kinds to their city, and the result would be salutary in various ways. It will, perhaps, be construed as sophistry if we claim that municipal taxes assessed on land alone will lower rents, and make real estate a better investment than it is under the present system. There are reasons for assuming this, but they are too long to enter upon here. The example of Philadelphia will be enough to prove it. Taxes on personal property are at best an uncertainty, and the land must, at any rate, bear nearly the whole, but people do not understand this. A Quaker land owner, in Philadelphia, when asked why he did not protest against taxes assessed on real estate alone replied, "if the taxes were not assessed on the land there would be no houses on it, and we want no change."

The laws relating to, or favoring, manufactures built Philadelphia, a vast prosperous city only 86 miles from the National metropolis and *entrepot* at New York. The port is sixty miles inland, reached by a river that is frequently closed by ice. The city, by all rules that apply in such cases, should have been swallowed up by New York, but instead of that it grows, and contains more houses than the metropolis.

It is a law of nature, not easy to explain, that whatever is subsidized dies. It is true of men as well as of industries, and if one goes out to seek successful manufacturing enterprises founded on the subsidy system, that is by direct gifts or advantages specially conferred, will find very few in this country, but they will find a great many failures. We do not, in this remark, include general privileges and inducements that will apply to all manufactures of a city. That is a different matter.

NOVEMBER MEETING OF THE TECHNICAL SOCIETY.

This Association held their regular monthly meeting on the 4th of November, at the Hall in the Academy of Sciences Building, in this City.

Mr. H. Y. Randal, C. E., Instructor in Civil Engineering in the University of California, was elected as a full member to the Society.

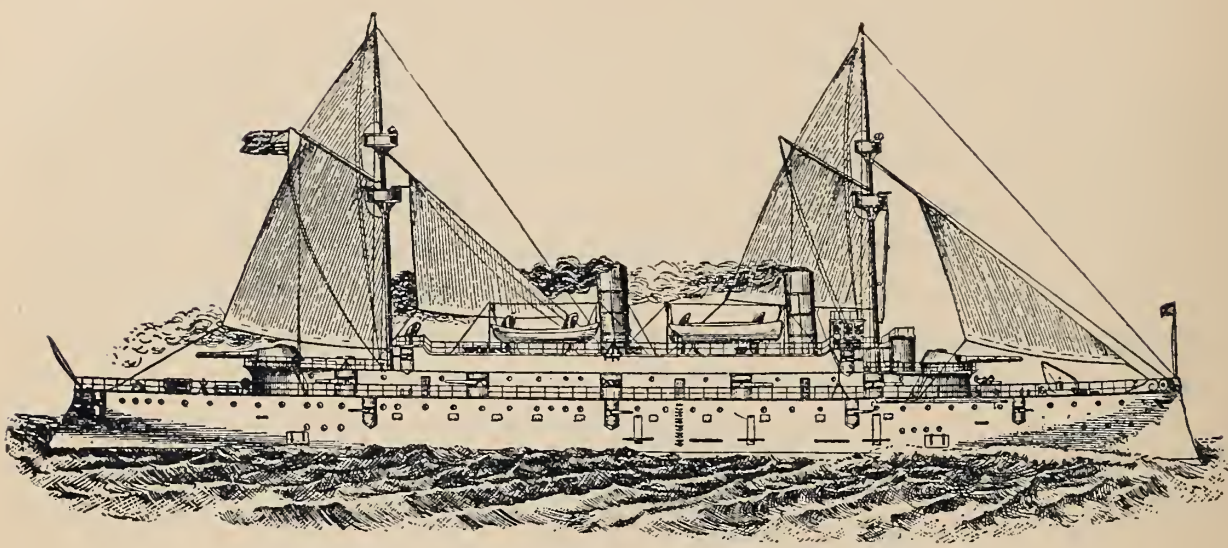
Three applications for membership were received and referred.

Lieutenant J. P. Finley, U. S. Army, delivered an address entitled "Climatic Features of the Pacific Slope, and their Relation to Atmospheric Conditions over the Plateau Regions." This interesting discourse was illustrated by numerous lantern slides prepared for the purpose.

The following resolution was unanimously adopted, after some courteous remarks by Prof. H. B. Gale:

Resolved.—That the Technical Society of the Pacific Coast tenders to Lieut. J. P. Finley its sincere thanks for his kindly interest in the welfare of the Society, and for his valuable contributions to its records.

Lieutenant Finley, who has been ordered East on some duty not made public, and also because of some changes in the Signal Service here, takes with him the warm wishes and admiration of his numerous friends on this Coast. He generously placed at the service of the Technical Society, and other associations of the kind, on this Coast, his extended knowledge and the result of his researches, in meteorology, as far as was consistent with his official position, and in so doing added a good deal to duties, arduous enough without this draught upon his energies, and we think some general testimonial from the various societies benefited, would be a proper and graceful acknowledgment to Lieutenant Finley.



U. S. CRUISER "OLYMPIA."

In addition to the notice given in our last issue, in respect to the U. S. Cruiser *Olympia*, launched at the Union Iron Works last month, the farther particulars below respecting her machinery will have interest to our engineering friends.

The drawing, for which we are indebted to the courtesy of the *Railroad and Engineering Journal*, shows the vessel with her canvas set, and is a geometrical elevation to scale.

There are two sets of triple expansion, inverted, direct acting engines with cylinders 49, 52 and 92 inch bore, 42 inches stroke. There are six boilers, two of them single-end, 15 feet 3 inches diameter, 11 feet long, each having four corrugated furnaces, four double end boilers of the same diameter, 21 feet 3 inches long. The pressure is to be 160 pounds per inch. The speed of the engines is rated at 128 revolutions per minute, and at that rate will develop 13,500 horse power, computed to drive the ship at 20.25 knots an hour or over 23 miles an hour. The bunkers are to hold 1,300 tons of coal which are supposed to propel the vessel 15,000 miles, or for 54 days.

The *Olympia* as she now lies thirty feet above the water is a formidable looking object. The plate work is smooth and the lines pleasing to what they will be when her mechanism, fuel, and armament, sinks her to the load line.

MISSISSIPPI LEVEES.

Mr. William Starling, chief engineer of the Mississippi River levee district, contributes to the *Engineering Magazine*, for November, an article on "The Mississippi Problem up to Date," that will be read with much interest by engineers in California who have to deal with our "alluvial" water-ways. We think Mr. Starling deals at too much length and somewhat irrelevantly with the views of Captain Eads in respect to the physical features of silt-carrying rivers and the laws that govern matter in suspension. To this, without further explanation, our answer is, that the country will be well satisfied if Mr. Starling will achieve results such as followed Captain Eads' work on the Mississippi.

Most of the points in controversy are not of much importance, and it must be remembered that criticisms at our day are made at the end of more than twenty years of experience, equal to a hundred years before Captain Eads time, and that this twenty or more years includes the Mississippi jetty system with the considerable data and inferences derived therefrom.

The writer concludes without qualification that, levees do not raise the beds of streams, and deals with the subject in the following words:

"The idea that levees tend to raise the bed of a stream is one of ancient date, which is still believed in by many persons. It is singular that it should ever have gained credence at all, for it is utterly opposed not only to all sound engineering principles, but also to all testimony. Velocity is lessened by the dispersion of water over the bank and is conserved or increased by their retention. The part of the water which is discharged over a weir is that part which is most nearly clean. Hence, in wasting it, not only have we weakened the stream and reduced its capacity for its burden, but we have not withdrawn a proportional part of the load. It is true that we have retained the sediment which otherwise would have been carried out into the flood plain, but we have also retained the vehicle which is to carry it, and in much more than sufficient quantity for that purpose. The evidence on this point as well as the reasoning is very well given by my friend Mr. H. St. L. Coppée, in the *Engineering Magazine* for August. The opinion in question is not entertained by any engineer familiar with the Mississippi, whether he be connected with the levee service or not. The members of the Mississippi River Commission are of all shades of opinion as to matters connected with river improvement, but not one of them believes that confining the waters has any tendency to raise the bed."

This we hold is far too sweeping in the face of so much evidence the other way, and depends wholly upon the factor of bottom scour, which in slow streams or water-ways may not exist in any degree to meet so sweeping a rule. We imagine there is not a competent engineer in California that will not concede that the bed of the Sacramento River has been raised by the shore levees. If not, a large share of the lands now guarded should be permanent lakes because the river is now far above their surface. The more safe conclusion is that no fixed rule will apply to these matters.

The argument against lateral outlets for flood water is well taken and the facts cited show that diminution of volume extends only for a short distance beyond such outlets, but one will wonder how such data was procured from breaks in the Mississippi levees, unless, as is not likely, that such breaks were expected and preparations made to observe the effect at various points included in the statements.

There is also presented the hypothesis, because it is no more, that deposition of silt depends upon an uneven mixture of the water, for example on page 250 it is said:

"On two sides of a river, at the same moment, one is acquiring and the other depositing, and one may be twice or thrice as muddy as the other. Did the reader ever see a muddy stream discharge into a clear one? They do not form a homogeneous river. The mud does not even keep together, but forms detached, circular, curdling eddies, with clear spaces between. This phenomenon occurs more or less along the Mississippi. Eddies or "boils" of extraordinary turbidity, thick as chocolate, alternate with comparatively clear portions. Sediment observations, therefore, unless taken with extreme care, may be valueless and even misleading."

This is no doubt correct in so far as points near the confluence of rivers and for some distance below, but our recollection of the matter, based on an observance at nearly all stages of water, is, that from Bayou Sara to the Belize, at least, the Mississippi water is quite homogeneous.

THE PORTER CENSUS.

We have several times called attention to criticisms of errors in Porter's political census of 1890. It was the first time, and, let it be hoped, the last time that a census will be mixed up with politics or put in the hands of a political partisan instead of an officer with the required scientific and technical ability of conducting so complex an undertaking. The Philadelphia people are now wondering over the Porter statistics of that City, in which it appears that in ten years the number of establishments increased 96 per cent., and that 103 per cent. in wages was paid to an increment of 33 per cent. in the number of hands, and 72 per cent. in product.

Ship-building is set down as having a capital of $1,291,776, and the annual product at $959,126. There is not a schoolboy of average intelligence in Philadelphia, or in any other American city for that matter, that does not know this is nonsense. The Cramp Company alone has a capital of $3,000,000 and the product has reached in that works $3,346,000 a year.

The *Ledger* in Philadelphia, Mr. George W. Child's paper, says:

"The only value of Superintendent Porter's census of manufactures appears to be in the complete demonstration that the Government cannot take such a census and obtain reliable data. It is a waste of money to complete and publish such statistics as these, for they will not be accepted as true."

Without referring back to the actual figures in similar statistics of the manufactures in this City, we will say from recollection that they are much the same as in Philadelphia, as was pointed out at the time of their publication.

There are half a score of well qualified American officers that could have been appointed for this work, and there was no need of selecting an Englishman, who as secretary of the *Tribune* tariff commission showed an incompetency, or capacity of controverting facts, that was notorious alike in this and other countries.

The loss in this census matter is two-fold, first in the vast sum of money wasted, and secondly in a missing link in our National statistics, which to the present time have been a matter of pride in this country.

THE GREAT EASTERN.

A question often asked nowadays is, why did not the *Great Eastern* succeed, when they are now building steamers nearly as large? The *Marine Review*, Cleveland, Ohio, thus fully answers the question:

"How plain now to naval architects, vessel owners, and in fact everybody possessing even a limited knowledge of the requirements as to power in large steam vessels, is the main cause of failure in the Great Eastern. Her power was entirely out of proportion to her great length and other dimensions. The dimensions of Atlantic liners are now approaching nearly to the size of the Great Eastern. The length of the Great Eastern was 680 feet, and her horse power 7,650. The new Cunard liner Campania, launched a few weeks ago, is 620 feet long, but her horse power will be 30,000, and it is said that the boat which the White Star line proposes to build at Belfast, Ireland, will be 700 feet long. It is the difference of power to which attention is called however, and in this connection the following table, showing dimensions and power of vessels constructed since the Great Eastern disappointed a waiting public thirty-four years ago, will prove interesting:"

Name.	Date.	Length ft.	Breadth ft.	H. P.
Great Eastern	1858	680	82	7,650
Britannic	1874	455	46	5,500
Alaska	1881	500	50	10,500
City of Rome	1881	546	51	11,800
Umbria	1884	501.5	57.2	14,321
City of Paris	1888	500	63	20,605
Teutonic	1890	550	57.5	13,000
Normania	1899	520	57¼	16,352
Fuerst Bismarck	1891	502.5	57.5	16,412
Campania	1892	620	65.3	30,000

Thus the explanation of the Great Eastern's failure as shown was her great lack of power.

The levees or embankments on the lower Mississippi River must be assuming a complete form again. In 1890-91 more than 17 millions of cubic yards were constructed in Louisiana alone. The total in Arkansas and Louisiana was 18,481,141 cubic yards, and the cost $3,353,390, of which the U. S. Government furnished about a third. The total length of the levees is 807 miles. It is here, more than anywhere else in the world, that will be observed the physical changes that are produced by confining the waters of a river. One theory is that the silt of rivers is deposited along their course, and in this way is formed the sedimentary lands through which the rivers flow. The other theory is that there is no lateral deposit at this day, and if not a scour, the matter in suspension is all carried out to the delta; also that embankments increase the velocity and scour, so the beds of rivers do not rise as is commonly believed. It is probable that both theories are correct, and the results depend upon circumstances. There are abundant proofs within historic periods to show that rivers may scour down as well as raise their beds.

LITERATURE.

Cassier's Magazine.

SEPTEMBER 1892.

This number, which is finely illustrated, has for a first article one contributed by Mr. Charles H. Werner, on "Some Fast Steam Yachts." Of these there are four. The "Norwood," "Vamose," "Now Then" and "Yankee Doodle," which, taken together, except the "Norwood," form, perhaps, as irrelevant and silly a set of names as could be devised.

The "Now Then" and "Norwood" were constructed for Mr. Norman L. Munroe, the publisher, the first by the Herreschoff Co., of Bristol, R. I. The "Vamose" and "Yankee Doodle" were built by Mr. C. D. Mosher, of New York. The "Vamose" for Mr. W. R. Hearst, of this City, and the other is the property of Mr. Edward Hatch, of Newark, New Jersey.

Experiments in connection with these fast boats, which run at a speed of about one mile in two minutes, or 30 miles an hour, have added a good deal to data respecting fast propulsion. For example, in Mr. Mosher's experiments it was proved that the speed of the short models compared to the finished boats varies as the square root of their respective lengths.

The "Vamose" is the boat in which the people here feel some interest, because it was expected that she would be brought out to run on San Francisco Bay. This vessel is 112 feet 6 inches long over all, with a beam of 12 feet 4 inches, draught 4 feet 11 inches. The hull frame is of steel, double covered with wood of ⅞ and ⅝ inches thickness, or 1½ inches of thickness in all.

The engines are quadruple; the first cylinder, 11¼ inches; second one, 16 inches; third, 22½ inches; and two final, or low-pressure cylinders, each 22½ inches diameter. The condenser contains 498 feet of surface. The engine and its equipment weighs 13½ tons, and develops 800 horse power. The boiler is of the Thornycraft pattern, 8 feet 4 inches by 8 feet 6 inches. The shaft is 5¼ inches in diameter, and the screw three-bladed 54 inches diameter. Of the speed of the "Vamose," Mr. Werner does not say anything, but it is believed to be, as far as tested, to exceed that of the other boats named.

Articles on "The Blast Furnace," "Modern Quarrying Methods," "Steam Engines," "A New Type of Pumping Engines," with other articles of merit, all relating to engineering subjects, go to make up a valuable issue. There are striking drawings of the engines of the warship *Ramillies*, of 13,000 horse power, constructed by Messrs. Thomson, of Glasgow. They are of the inverted side-by-side, single-leg pattern, a mass and maze of parts.

The Californian Magazine.

NOVEMBER 1892.

We received, some time last month, a notice, not now at hand, that the *Californian* could not be exchanged for serials having a less subscription rate, or words to that effect, and expected, in the next number, to find an array of especially valuable matter accordingly.

By chance the Magazine was opened at what is called the "Publishers' Department," which nearly all readers will construe as a portion of the regular matter, and there found a three-page "write-up" notice and portrait of a Mr. Dingley, and "Drifted Snow Flour," which he makes, or sells, or both. Whether the article is to praise Mr. Dingley's adroitness in advertising the flour, to explain his family affairs, which are dragged in, or in the interest of the "Drifted Snow" is not clear, but of one thing we are sure, he could not insert the same article in this Journal for the proceeds of all the flour he can sell in a year.

It has been our privilege and pleasure to notice favorably whatever is commendable in the present, or other publications of the kind, but we draw the line at what are called "write ups," and a prostitution of reading matter to adventitious advertising purposes.

"Publishers Announcements" are beginning to appear in several otherwise high class serials, and are a deception the same as the catch advertising stories. Such matter descriminates against legitimate advertisers, who should withdraw their patronage from any journal that will sell its reading matter for money. For the rest, the Magazine is well made up, well printed, and a credit to the publishers and editor.

The Street-Railway Journal.

OCTOBER 1892.

The publishers of the *Street-Railway Journal*, of New York, have issued a sumptuous souvenir edition for October, for the occasion of the Cleveland Convention of the American Street Railway Association, on the 19th, 20th and 21st of last month. This is, perhaps, the finest edition of a serial devoted to industrial interests that has ever appeared in this country. The advertising sections being worked in various colors, and the plates in the reading matter prepared and printed in a style that seems marvelous. The portraits especially, of which there are a large number, bear witness to an attainment in the art that must be if not final, nearly so.

The growth of this important publication has been phenomenal. It seems but a short time, and is indeed only four years, since the Editor was the guest here of Mr. Hallidie and officers of some of our City lines, at which time the Journal was but an embryo of its present self. This growth is but commensurate with the vast interest represented and the result of competent management. Cleveland is a congenial center for such a convention, and the Journal has done full honor to the occasion.

Simple Lessons in Drawing for the Shop.

BY ORVILLE H. REYNOLDS.

The title above we think should be "Simple Lessons in Draughting," because both "drawing" and "shop" are indefinite terms, but the title need not interfere with this unpretentious but first really good elementary treatise that has appeared on the subject of plain, geometrical draughting, such as is required and practiced in a works. There is enough, and not too much, for beginners, who, by the nature of the art, must acquire the main part by experience and "absorption." There is also a good deal that old draughtsmen will find useful and new.

The diagrams, of which there are quite a number, are well chosen, and a merit of the whole is that the work is evidently a reflex of the author's methods, he being chief draughtsman of the Northern Pacific Railway Company.

We have, on more than one occasion in this Journal, claimed that works on machine draughting were of little use except to teach methods. This is evidently the assumption on which the present little treatise is prepared, hence it is directed to *how* to make drawings, not *what* to draw. The latter is learned by actual practice and observation in the works, also from a knowledge of construction. The former can be learned from printed instructions, perhaps soonest in that way, and as is here presented.

The book is published by the Debs Publishing Co., at Terra Haute, Indiana, contains 83 pages, and is sent for one dollar.

The Tariff Controversy in the United States, 1789 to 1833.

BY PROFESSOR ORRIN LESLIE ELLIOTT.

This work is issued by the Leland Stanford, Jun., University, Palo Alto, California, and covers particularly a period of forty-four years, from 1789 to 1833, in the economic history of this country. We are at a loss to know what to say in respect to this work. Its completeness as an impartial and able history, written in a diction not common in our day, is completely swallowed up in a greater fact, here made plain, that there has been a decadence and marked retrogression in a knowledge of economics among public men in this country.

The tariff, which is now discussed as an obscure problem, and under all kinds of sophistical assumptions, was throughout this older period no mystery. Its nature, effects and relations were clear to a score of men that discussed the subject at various times in all of its bearings, differences of opinion being confined to the ultimate effects on the country, and the injustice or fairness of this method of taxation.

Clay, Webster, Calhoun, Hamilton, Ames, Adams, Bidwell, Dallas, Ellsworth, Franklin, Madison, Jefferson, Tyler, Van Buren, and others in their speeches and writings never descended to the sophistries now existing, and taught by the weaker statesmen of our time.

Whether in favor or opposed to custom taxes no one was silly enough to claim, or hint even, that it was other than a mode of taxation. No one ever thought of such a proposition as that a tariff would reduce prices, or promote industries other than the beneficiaries of the system. One pauses to reflect what Hamilton, Jefferson, Fisher, Ames, or John C. Calhoun, would think if reinstated in the flesh and set down in the Halls of Congress at this day to listen to a tariff debate. They would conclude that all understanding of the subject had died out, and that gross ignorance, coupled with personal ends, had usurped the attainments of their time.

This is a melancholly view of the subject, as here presented, heightened too by the method of its presentation by Professor Elliott, who deals with his subject impartially, and, as before said, in a style and manner not approached, so far as we know, in similar writings of our day.

To attempt a review of the work exceeds the limits here at command, and the most we can do is to recommend its careful perusal by all thoughtful persons in search of truth, and desirous of understanding the nature and effects of tariff taxes assessed on imports. The book contains 272 finely printed octavo pages, and is sold unbound for one dollar.

The Free Trade Struggle in England.

BY M. M. TRUMBULL, M. C.

The Open Court Publishing Company of Chicago, send copies of this work, which at this time is one that should be carefully read by both the advocates and opponents of what is called the "protection" system.

The subject is one of absorbing interest in the United States, and promises to be for some time to come. Certainly there is no better way of forecasting a National policy than from the experience of other countries, and while a good many will contend that circumstances vary in different countries, there can be no difference in the fundamental laws of trade and commerce.

We cannot attempt to review the subject matter further than to say that Mr. Trumbull has gathered up the fragmental but official history of that momentous period in British history, when commerce and manufactures were freed from the interference of Legislation.

Laws passed there between 1830 and 1840, prescribed not only the prices that people should pay, but even what kind of clothing they should wear when alive, and what kind they should be buried in. First one interest and then another was interfered with by sumptuary laws.

Adam Smith, half a century before, had laid down in the *Wealth of Nations* certain fundamental laws governing values, trade, and manufactures, which comprehended in fact the present fiscal system of England. He showed the sophistry of what is called the "mercantile theory" of trade between nations, but the people could not understand this great work of his, which since then, more than any other ever written, has influenced the affairs of mankind, and fairly viewed, the events that form the subject of Mr. Trumbull's work are those attending on the application of Adam Smith's philosophy.

There is no more interesting reading at this time than the copious extracts from speeches made in Parliament and elsewhere in support of, and against, customs taxes, especially on corn, or as we may say, food, because in England the term is applied alike to wheat, barley, oats, maize, and so on.

Fifty years have not been long enough for the Tory element in England to forget the abridgment of their privileges, nor the affront put upon them by the Manchester school of grimy trades people who dared to meet and vanquish them in economical debate, and there is yet in England a strong desire on the part of various interests to profit by some kind of special legislation in their favor, but that we imagine is at an end in England.

A paper covered edition of 300 pages is sold at 25 cents, in cloth 75 cents.

Methods of Industrial Remuneration.

RY DAVID SCHLOSS.

The author of this book says, in the introduction, that of all the questions which press for answer at the present time, none is fraught with weightier issues than the labor problem. He has addressed his work to this problem, not, as is too often the case in such writings, to moralizing and theorizing on it, but to real practical work, finding out by laborious effort the various ways in which labor is paid for.

The book deals with methods of remuneration, as its title indicates, and does not touch upon the "amount" of wages, and we suggest that if the same author would take up the problem of amount, as he has done the method of wages, the whole problem would be covered by the two treatises.

Mr. Schloss writes in England, and deals mainly with facts in that great industrial center, but does not, by any means, confine himself to that country. He has gone out into various works, inquired, observed and noted facts precisely as they exist, and, with one exception, has given a complete account of the various methods of industrial remuneration as it is practiced in various industries covering a wide and diverse field. This work must have called for an amount of time and actual labor not often bestowed on a subject with no other object than writing a book.

The different kinds of wages he classes as: time wages, piece wages, task wages, progressive wages, collective wages, collective task wages, collective progressive wages, contract work, and coöperative work. All of these systems are described in an exhaustive way in twenty-nine chapters, making up over 300 pages octavo size.

The exception, above noted, relates to contract work, or what we have called estimate work in various articles on the subject heretofore published in this Journal, and here treated briefly as contract work. It is evident that the facilities for investigation were not so full in this case as in others, and it is not to be wondered at, because it is more or less a development in each works where carried out, and there is no object on the part of employees in declaring and explaining it to the public. In fact there is a strong incentive in England to conceal a system that has had more to do than any other cause in enabling employers there to pay men twice as much wages as are earned on the Continent of Europe, and, at the same time, produce work at a lower labor cost.

It is easy to see that Mr. Schloss has been confined in his researches into this method of remuneration to *ex-parte* statements, and the fault is that this branch of the subject has not occupied a larger part of the treatise, presenting, as we contend, the most probable solution of the skilled-labor problem in future.

The author, properly as we conceive, condemns the 'profit-sharing" scheme, and, as it is the most common among attempted methods of conciliating labor, devotes more space to that than any other method treated upon, giving a tabular list of sixty British firms that have what may be called a profit-sharing system, also the rules under which some American firms conduct profit sharing.

Chapter XXII, entitled "A Critical Examination of the Methods of Profit Sharing," is the most ably written one in the book, showing that the author has considered it in every possible aspect. Preceding this the theory and practice of the method is considered, and we doubt if ever there will be again an analysis of the system more complete and impartial.

Those considering, practically, some method of dealing with skilled labor should first read and study this book, and it would not be far wrong to add no other, because the literature of the subject is here comprehended and set forth in connection with observed facts, so many and so wide, as to form an infallible guide.

The book is published by Putnams, Sons of New York, and by Williams and Norgate, London.

Messrs. Mason, Fenwick & Lawrence, patent lawyers and solicitors, of Washington, D. C., have issued a neat little book giving useful information respecting patent procedure. This firm was established in 1861, with the Hon. Chas. Mason, former Commissioner of Patents, as the senior member; Mr. Robert Fenwick, counsellor at law, and Mr. DeWit C. Lawrence, also a lawyer, and for nine years an officer in the Patent Office as an Examiner, member of the Board of Appeals, and acting Commissioner of Patents. Mr. Edward T. Fenwick, counsellor at law, has recently become a member of the firm, which is one of the most able and reliable in the profession.

The Hon. Charles Mason, when Commissioner of Patents, introduced more reforms in the Office rules and methods of procedure than any other Commissioner before or since his time. Nearly all of his innovations and changes in procedure have continued to the present time.